THE

ELECTRICAL REVIEW.

VOL. LXIX. SEPTEMBER 15, 1911. No. 1,764.

ELECTRICAL REVIEW.

Vol. LXIX.] CONTENTS: September 15, 1911. [No. 1,764.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

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BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to MR. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1911 EDITION

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

RAILWAY COMPANIES AND MANUFACTURING.

PUBLIC attention has been for some time past acutely directed to the functions and methods of railway companies, and at such an important juncture it is not amiss to speak of specific reforms which might be advantageously considered. It is generally accepted that institutions as well as individuals, without occasional stimulative criticism or special incentive in the shape of competition, are apt to fall into methods of working which are neither good for the institutions themselves nor for the public which they serve. In some respects the railway companies have been affected with lassitude, while in others they have permitted themselves a freedom in methods of competition which are wholly indefensible on commercial grounds. Travellers to various parts of the country served by competing lines have often been struck by the fact that three, and sometimes four, trains have left a London terminus within a few minutes of each other, bound for the same town, and this arrangement has been persistently followed for some years. Then, again, in the collection of merchandise there has been an extraordinary degree of competition, and often four and five companies have been struggling to secure a certain freight. In this respect we must give the railway companies full credit for employing agents who are remarkably active and hardworking in securing business for their respective companies, but while the system may have developed the activity and keenness of the railway employé, it is generally admitted to be a wasteful system, and one which must have seriously affected the cost of carriage. In this respect it would be extremely interesting to know what the cost of collection and haulage to the railway terminus really is, for we strongly suspect that it constitutes a very serious proportion of the total cost of carriage. The experience of the railway companies in the United States is that the cost of haulage to the terminus is far in excess of the cost of the railway haul.

It is fortunate, however, that a good deal of this duplication of trains and the unnecessary competition for goods traffic has been very much modified, and by virtue of agreements arrived at between the different companies, very important economies have been effected in these two directions. While, however, many of the officials have been fully alive to their wasteful methods, the reform has not come from the inside, and it has been entirely due to the combined efforts of the shareholders that the companies have been driven into making some sensible arrangement with one another. If, therefore, the railway companies have been lacking in instituting such obvious reforms as we have indicated, it is highly probable that great improvements could be accomplished in other directions, and it is hoped that the pressure of the new conditions which may arise in regard to labour may result in a careful and sustained effort being made to effect economies. Certainly before any

attempt is made to burden the already harassed trader with higher freight charges, the possibility of which has been already indicated by the railway companies, a close examination should be made into every possible reform.

It is not our intention now to say anything further with regard to the labour question, for the whole case of the companies and their servants is undergoing the closest investigation, but while this examination into the working of the railway systems is being conducted, it is highly opportune to draw very serious attention to certain functions which the railway companies are carrying out, and which, we think, are open to grave criticism.

Railway companies in this country have been for the most part manufacturers of their own plant and machinery. In this respect they differ from all the great shipping companies and from most of the great railway companies abroad. We are prepared to hear a great deal said in favour of this policy, but we fear that in many respects it has proved to be a very unsound one, and the failure of a manufacturing policy on a railway might influence a much wider circle than the railway interests. The manufacturing policy of many of the railway companies has not been confined to one or two special branches of railway work. Most of the companies build their own locomotives and rolling stock, but some have gone much further than that; indeed, one company, probably the mos ambitious of all the lines, rolled its own rails, and went so far as to build electric lighting machinery. Yet this same company, in spite of its comprehensive manufacturing programme, for a time at least fell hopelessly behind the rest of the world in its design of locomotives.

On broad grounds we are strongly inclined to the view that railway companies should never have been permitted to undertake manufacturing of any description. We have been told that railway companies knew their own requirements in respect of locomotives better than outsiders, and consequently they built exactly what they required. There s a good deal of fallacy underlying this view, and it is llustrated by the fact that whenever a mechanical engineer of a great railway line has laid down his work his successor has designed a new type of locomotive. To demonstrate still further the unsoundness of this contention, locomotives designed to meet the conditions of one line have been tried on other systems, and in more than one instance the strange locomotive has proved to be better than the home-made machine. Not for a moment are we arguing against the skill of locomotive engineers or the honesty of railway officials, in suggesting that locomotives designed outside the railway companies' works should be superior in design and cheaper in cost. It is clear that a manufacturer of steam locomotives who wishes to succeed must not only manufacture cheaply, but his designs must embody the latest ideas suggested by experience. It follows, therefore, that if railway companies were buying outside they would gain the benefits of the accumulated experience of a number of manufacturers without the heavy expenses necessary to the development of a new type of machine. There would have been a great national gain if railway companies had been purchasers instead of manufacturers, because under such circumstances there would have been developed in this country vast industries which would have dominated the Colonial and many of the foreign markets. If, for instance, locomotive builders had received the support of the home railways they would have become the suppliers for the world, instead of being a very poor second to the United States. In regard to this particular industry, it is too late to apply a remedy, but in the next few years the railways will be to a large extent electrifying their lines, and we sincerely hope that the electrical manufacturers are not to be called upon to carry out the original work, which is usually of an experimental nature, with the prospect of all subsequent work being done by the railway companies themselves. We regret to note that in at least one instance this course has been adopted, and the railway in question is actually making its own motors and kindred apparatus. If railway companies are wrong in manufacturing steam locomotives, they are likely to be still more so in the case of electrical machinery and apparatus, which if not undergoing radical changes is bound to be subject to minor improvements, and clearly these are best obtained in the workshops of the country. On such a vital matter as this the electrical industry should be heard, and if the large manufacturers of the country will carefully watch events, they can make combined representations in the proper quarter, which should do much to prevent in electrical work a repetition of what has occurred in other directions.

Technical Exhibitions.

Technical exhibitions, particularly when international in character, exert a broadening influence on the ideas and knowledge of all visitors, no less important than that due to modern facilities for travel and the intercommunication of news. The latest products of the most advanced workers in every field are brought together at a central spot and placed at the disposal of every *bona fide* inquirer. By no other means could the latter obtain so much current knowledge; however wide his travels, many of the exhibits would be inaccessible, the cost of viewing even a fraction of the whole would be enormous as compared with that of visiting the exhibition, and under no other circumstances could the latest developments in so many fields be accessible at one time and place.

As a preventive of scientific and technical "provincialism," exhibitions are invaluable, and in many respects they are efficacious and far-reaching. The language bar still prevents many engineers from fully appreciating the latest developments in other countries, but, at an international exhibition, the best of the latest apparatus is actually placed before him. Added to the concrete demonstration of apparatus of every description, there is sometimes arranged a series of papers and discussions which, by reason of the cosmopolitan assembly present at their delivery, are of great value to every participant.

To an important international Exhibition, most civilised countries send competent delegates; on their return, the latter prepare detailed reports of their observations and conclusions—thus affording the best substitute for an actual visit to those who were unable to attend the Exhibition, and providing a permanent expert record of the latter as affecting the current technical position of the various nations or communities concerned.

Words can hardly do full justice to the universal value of exhibitions; the mere congregation of numbers of experts in every field should alone be a sufficient inducement to persuade every worker to avail himself of the exceptional facilities—personal and professional—at his disposal. The forthcoming Electrical Exhibition at Olympia is confidently expected to excel that of 1905; yet, if it were far below the standard of the latter, none but the most weighty reasons should prevent any electrical engineer from attending it on at least one date.

WIRELESS CONNECTORS FOR COOKERS.

By DONALD SMEATON MUNRO.

Most supply engineers are anxious to encourage the extension of electrical cooking, and in every town where there is a supply there are to be found more or less complete examples of electric kitchens. Reliable and cheap electrical cooking utensils are now obtainable, and energy for this purpose is charged for at a specially low rate. Modern schools of cooking teach their pupils the use of electrical heaters, but before cooking by electricity becomes universal, it is necessary to make the working arrangements so simple, safe and strong, that there is little chance of danger or damage to apparatus even in the hands of the common cook or general servant.

Everyone who has had experience of electrical heaters knows that the flexible connections are a perpetual source of trouble. It is usual to employ an ordinary wall socket and plug for flexible; and on the ends to which the heaters are attached are fixed various forms of socket connectors. These are made of china, vulcanite, marble, fibre and various other materials which are apt either to break, or to melt when heated, or which are affected by damp. The method of fixing the ends of flexible cord into these connectors is almost invariably bad, with the result that bare wire ends come out at awkward moments, or the wire breaks where it enters the socket. The insulation of the flexible is soon destroyed by the heat, grease, and water associated with cooking, and while flexible stands fairly well on lamp standards, &c., it soon succumbs to the constant moving of cooking utensils. Lengths of cable connections are always getting in the way of dishes, and are the cause of much upsetting.

If the flexible cord does not contain an earth wire, or is not armoured, the risk of accident is very considerable, and a shock or flash may mean the abandonment of the whole electrical kitchen.

Considering the nature of the work, it is inevitable that occasionally there is leakage on some of the apparatus, and while it is possible to fit a wall socket with an earth connection, it is awkward and clumsy to fit such a contrivance on all the little heaters which may be used.

When leaking utensils connected by flexible are kept on an earthed metal surface, they are comparatively safe, but when they are lifted up and the cook is also making contact with a metal surface or stone floor, then there is apt to be trouble. It should be remembered with regard to shock, that electrical cooking is most popular in districts where the voltage is comparatively high, as the mains are less costly. Altogether it would appear extremely desirable, indeed vital, to the general adoption of electricity that flexible cords should be got rid of altogether. They are eliminated if ordinary utensils are laid on an electrically-heated hot plate, but such a method of heating is very wasteful.

Mr. Gray, in his paper read before the Institution of Electrical Engineers, referred to the awkwardness of flexible connections, and proposed a neat method of disposing of surplus cord by passing it through holes in the table and around weights on the telephone jack principle. He also mentioned that there was no wireless method of connection on the market.

The following description of a method of wireless connection recently devised by the writer may be, in view of the foregoing facts, of interest:—

The qualities aimed at were that the connector should be of the simplest character, that it should be practically unbreakable, and that it should be possible to clean it with soap and water; that the earthing arrangement should be such that a shock would be extremely unlikely, that it be adaptable to different sizes of heaters, and that a multiplicity of different sizes of switches and sockets be avoided.

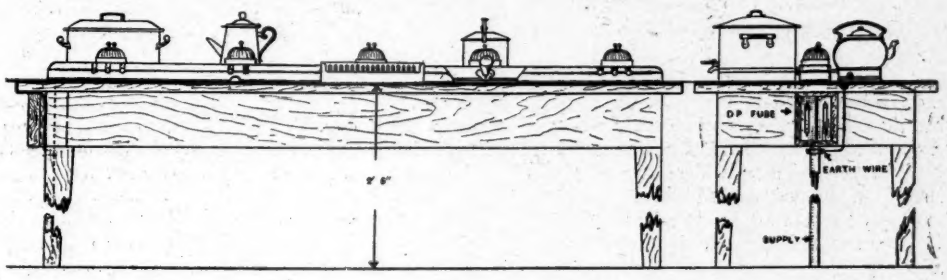


Fig. 3.

Single heaters with two plugs or triple heaters with three plugs may be used, and it is necessary to fit the heaters with standardised parallel prongs, say, $\frac{1}{4}$ in. diameter and with centres $\frac{3}{4}$ in. from the base. The prongs, for a reason given later, may be about $2\frac{3}{4}$ in. long for big heaters and $1\frac{1}{2}$ in. long for little ones, and have, say, $1\frac{1}{2}$-in. centres.

A metal or wood table, or shelf, may be used, so long as the surface is faced with metal, usually zinc. The surface is "earthed." On the top of the table are screwed two lengths of grooved and polished slate. These form a casing and cover for the cables, and also carry the contact sockets. Tube contacts are fixed at intervals across the seam between the two slabs of slate. These contacts consist of pieces of tube brazed to small terminal blocks. The blocks are held in the grooves of the slate, and hold the contacts firmly without further fixture. The tubes present a perfectly smooth and uninterrupted channel for cleaning-out purposes. The negative cable is carried in a groove in the lower slate, and is looped through its negative contact terminals. The positive is carried in a groove in the upper slate, and is looped through the switches which sit on the top of the slate. Switch wires pass through holes to the positive contact tubes.

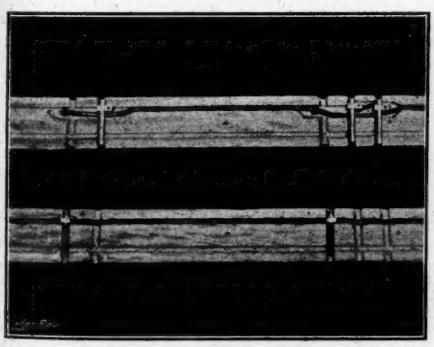


Fig. 1.

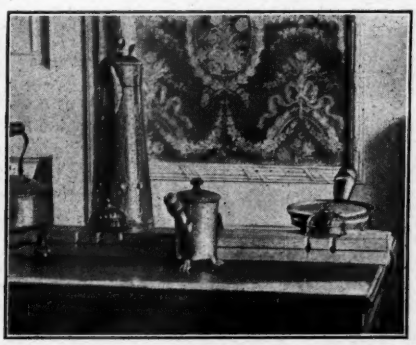


Fig. 2.

The method of wiring a single circuit feeding one two-socket and one three-socket connection is shown in the illustration, fig. 1. The two lengths of grooved slate are shown screwed together and fixed to a small experimental table in fig. 2. The slate may, of course, be grooved to contain additional circuits if desirable, and each local plug switch may have its own protecting fuse. The switches also may, in some cases, be of small rheostat pattern, and it is desirable that their cases be watertight.

Fig. 3 shows a cooking table prepared for kitchen use, with replaceable D.P. fuse and "earth" connection. The

inner surfaces of the two slates are so cut that when they are screwed together and to the table, there is no possibility of water getting through the seam into the cables.

The upper slate has vertical grooves to guide the prongs of cookers into their sockets, and, of course, as the prongs are inserted the metal bottom of the vessel makes a sliding and good electrical connection with the earthed table top. The ends of

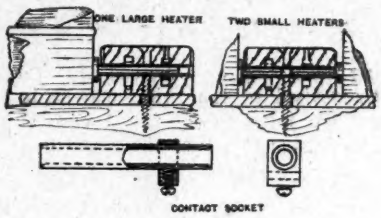


Fig. 4.

the contact tubes do not project to the surface of the slate, so when the vessel is withdrawn it is quite free from contact with the circuit, even should the switch be accidentally left in the "on" position. There is, therefore, no possibility of shock, as the utensil cannot be lifted till it is clear of the contacts, and the supply pressure might even be 500 volts with safety—with a corresponding reduction in size and cost of supply cables.

The design of the tube contact sockets is shown in fig. 4. The positive and negative tube sockets are of the same simple type and are interchangeable. They are easily replaced without fixing screws, should they in time become fused at the ends owing to neglect of use of the switch.

A special feature of the design is that heaters may be supplied from either side of the plug socket, and the apparatus is economical in cost and space owing to the ability to use one pair of plug sockets for two utensils.

Overloading of a circuit is automatically and simply prevented by adopting two standard lengths for prongs. The larger heaters have the longer prongs, and when these are inserted they project so far through their tube sockets that a heater cannot be inserted from the other side. Small heaters have prongs less than half the length of the tube socket; two small heaters may, therefore, be in connection at once on the same contacts. This device enables the switches to be uniform and tends to keep the fuse within control.

The sale of heaters will gain considerable impetus from the Olympia Exhibition, and the writer offers to manufacturers the above suggestion for getting rid of some of the chief drawbacks to electrical cooking.

ELECTRICALLY-DRIVEN AUXILIARIES FOR SHIPS PROPELLED BY DIESEL ENGINES.

By A. P. CHALKLEY, B.Sc.

All engineers are at the present time taking a keen interest in the question of the application of the Diesel engine to marine propulsion, the solution of which threatens to cause a greater revolution in marine engineering than any of the last 50 years. It is well known that any great change draws in its train a host of minor modifications, which are in themselves of vast importance, and upon the success of which the possibilities of the main question may to a very large extent depend.

The point could hardly be better exemplified than in the case of the Diesel marine engine. The advantages of its employment, instead of the steam engine, need not be entered into here, but in view of all that has been written on the subject, all the work which is being carried out to perfect the Diesel engine, and all the hopes which are being expressed as to its possibilities, it cannot be too strongly urged that more attention should be devoted to all the apparently minor details involved, which perhaps as much as anything else will determine the success or failure of the Diesel-propelled ship.

More and more has it been realised in the last few years by marine engineers what an important bearing on the successful running of a ship, particularly in the case of larger vessels, the auxiliary machinery is capable of possessing, and yet it cannot be denied that in all the discussions relating to the employment of Diesel engines for marine propulsion, this question has been kept steadfastly in the background. In fact, so consistently has this been the case, that several shipowners and others interested have been forced into the impression that there is some difficulty in the matter of the operation of auxiliaries in a Diesel vessel, and it is evident that the spreading of such an impression may have a very detrimental effect on the future development of this new motor for marine work. This is all the more to be regretted, as a proper examination of the question of auxiliaries can only lead to the conclusion that they can be in every way more advantageously and economically operated in a vessel propelled with Diesel engines than in a steamship.

The applications of electricity at sea have in recent years been steadily enlarging their sphere with the greatest success, both from the point of view of economy and also of convenience of operation, and even if the steam engine or turbine is to be generally retained for main propulsion, the tendency to employ electricity for all auxiliary drives and other uses bids fair to increase to such an extent as to render the steam-driven auxiliaries unnecessary for all purposes. With ships employing Diesel engines for propulsion, where no steam is in the ordinary way available, it seems natural to expect that the step which is now being made with some caution in steamships should be hastened, and electrically-driven auxiliaries should without question become universal.

The employment of electricity at sea, however, has had to be pushed forward by its advocates against the most strenuous opposition of the more conservative marine engineers, and this feeling of distrust has had its effect on the design and arrangement of the auxiliaries for some of the Diesel engine boats which are now under construction. The result is that some of these vessels are employing compressed air for the auxiliary drive, whilst others are even being equipped with small donkey boilers to provide steam for the auxiliaries—an arrangement for which it is difficult to find an excuse.

It is known by long experience that there is no usual auxiliary on any ship which cannot be satisfactorily driven by electricity—pumps, winches, windlasses, fans, steering gear, cranes, lifts, hoists—and all the further auxiliaries introduced by the Diesel engine itself are likewise suitable for the electric drive. It is true that a large amount of compressed air is necessary for the main engine, and in most cases a separate air compressor is provided, driven independently of the main engine. For this reason in small vessels the use of compressed air for the very few auxiliaries, even though the economy is of the worst, due to the air not being expansively, may not be considered irrational, inasmuch as it saves a certain amount of initial expense. But to introduce a steam boiler, as has been done in one or two instances with fairly large vessels, is a conservative policy such as would not have been expected from any ship owner who has the temerity to employ Diesel engines at all.

It may be mentioned without comment that the largest Diesel-propelled boats now being built in Germany, and notably the Hamburg-America liner of 9,000 tons with Diesel engines of 3,000 H.P., are employing electricity solely as the motive power for auxiliary drive. The economy in operation which can thus be obtained is so great as to be comparable with the economy due to the main engines. The dynamos for the supply of power are driven by Diesel engines of the most efficient and well-tried land type, and it is not difficult to realise how important this economy may become when it is considered that in steam vessels of moderate size, about 20 per cent. of the steam raised in the boilers is required for the auxiliaries. Against this arrangement of the exclusive use of electricity, it cannot even be urged that Diesel-driven dynamos are in any sense a novelty at sea, inasmuch as they have been employed in battleships for the last six or seven years. Apart from other considerations, the fact of their readiness to start up at a minute's notice is at least a matter to be borne in mind,

since with steam auxiliaries on a Diesel-propelled ship the main engine loses its advantage of readiness for immediate operation owing to the necessity of raising steam for the auxiliaries.

The question of the auxiliary compressor for the main engine is the most interesting and important matter in connection with the general aspect of auxiliary driving for Diesel ships. This compressor must necessarily be of considerable power, and in most cases for this reason it is preferable in any case to drive it by a separate Diesel or other oil engine, rather than by electricity. An arrangement which has, however, been adopted, and is very useful in certain cases, is to have it capable of being driven from one of the electric generating engines, either direct or by belt, the dynamo being out of operation when the compressor is at work, and *vice versa*, for it must be remembered that for long periods the compressor is not required.

That electricity will eventually be universally employed for all auxiliary driving in Diesel-propelled vessels cannot be gainsaid, and it is to be hoped that some endeavour will be made to cause the British shipowners, who are now considering the question of the employment of the Diesel engine, to see that this would be of immense utility and great economy.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Lift Accidents.

At frequent intervals the Press reports lift fatalities, which vary in their nature from those to porters in large goods lifts to those to children in apartment houses, and a verdict is generally brought in of "Accidental death," with a rider from the jury suggesting some additional safeguards.

When we consider that the number of people carried vertically bears a considerable ratio to those transported horizontally, and that lifts may be deemed public conveyances, it would seem advisable that the details of lift construction should come under the supervision of some governing body, such as the Board of Trade or the London County Council. All railways must receive a certificate from the Board of Trade, following a careful inspection, before they can be opened for public traffic, and in the case of the tube railways the lifts, as an essential part of the system, were carefully inspected and passed upon by a supervising officer of the Board of Trade.

The majority of lifts are constructed to the specification and under the supervision of either architects or their consulting engineers, and in most cases do not come within the purview of one who is an expert and authority on such matters. Were a governing body to prepare a set of conditions with the help and advice of lift experts, covering the various conditions met with under different forms of lifts, I feel certain that lift manufacturers would welcome such regulations, that the architects and others involved would be relieved of a grave responsibility, and that the public in general would be far better safeguarded.

Gilbert Rosenbusch.

London, S.W., *September 9th*, 1911.

Quartz in Electrical Heaters.

I am preparing a paper on "Electrical Heating and Cooking Apparatus," and shall be much obliged if any of your readers can inform me what firm or individual was the first to employ quartz or silica in the construction of this kind of apparatus. I am, of course, aware that these substances have been used for this purpose in this country, and the Continent, and America, for some years, but I have not been able, so far, to ascertain definitely who was the first to make use of this material for this purpose. Thanking you in anticipation—

M. Taylor.

Edinburgh, *September 11th*, 1911.

PRIVATE BILL LEGISLATION OF THE PAST SESSION.

[BY OUR PARLIAMENTARY REPORTER.]

WITH the promotion of a large number of Bills for powers to run railless trolley systems of tramways in different parts of the country, it looked at the beginning of the past session as if there would be a revival of interest in electrical matters in the Committee Rooms of Parliament; but these hopes were quickly shattered when the Duke of Bedford's Committee of the House of Lords, charged with the consideration of a group of Bills promoted by private persons, threw out the Matlock district scheme, which was fiercely opposed by the local authority, largely on the ground that a heavy cost would be thrown upon them in connection with the repair of the roads. This decision led to the dropping of practically all the privately promoted Bills, although the Brighton, Hove and District Bill, which was brought forward by the Brighton, Hove and Preston United Omnibus Co. was eventually passed in an emasculated form. The Bills dropped were the Croydon and Southern District Railless Traction, the Macclesfield and District, the Malvern Electric Traction, the Oldham and Saddleworth District, the Rotherham, Maltby and District and the Western Valleys (Monmouthshire). Of the railless traction Bills promoted by local authorities, Rotherham obtained powers to run trackless trolley vehicles on specified routes after January 1st, 1912, and Northampton, Halifax and Chiswick after January 1st, 1913, on the certificate of the Board of Trade. All these Bills came before the Police and Sanitary Committee, whose object in delaying the powers is to give time to test the working of the systems sanctioned last year to Bradford and Leeds, which are now in operation with satisfactory results. In one case only, that of Rotherham, do the specified routes extend beyond the boundaries of the local authority, and each of the authorities on the intended routes supported the proposal.

Two of the local authorities who obtained railless traction powers also applied for an extension of their existing tramway powers. Northampton Corporation, for instance, got considerable powers for new tramways, and successfully fought the railway company with regard to the carrying of the rails over a level crossing on one route, after the Committee considering the matter had mainly endeavoured to bring about an agreement between the parties for the construction of a bridge. Halifax Corporation obtained authority to spend nearly £80,000 on new tramways. A Welsh local authority, the Aberdare U.D. Council were empowered to construct both tramways and the railless traction system in their portion of the "Happy Valley," after several previous unsuccessful attempts. The Paignton U.D.C. obtained conditional powers regarding a piece of tramway authorised to be constructed by the Torquay and Paignton Co., and the Newcastle-on-Tyne Corporation obtained part of the powers they applied for as regards the construction of tramways. As usual, the London County Council brought forward an ambitious programme, and it followed as a matter of course that a number of the proposed routes had to be dropped owing to the lack of consent on the part of different road authorities. However, a number of proposals for new lines were agreed to, including a junction line in the Seven Sisters Road, which will provide a through service between the County Council's lines and the system of the Metropolitan Electric Tramway Co. The Newcastle-on-Tyne Corporation also succeeded in getting authority to provide a number of extensions, but failed in regard to some of the suggested routes. The Southampton Corporation had a few modest tramway proposals which went through unopposed, and the Hull Corporation were also successful in their promotion. The Belfast Corporation obtained powers to extend the Holywood Tramway, and the Dover Corporation got an extension of time for the construction and completion of street works and tramways already authorised. Other tramway Bills carried were the Bristol Tramways for an extension of time, and the South Lancashire Tramways for additional tramways in Little Hulton, Farnworth and Worsley. The Brighton and District Tramways Bill for the

incorporation of a company with a capital of £210,000 and construction of about 10 miles of tramway was dropped early in the Session, after a prolonged discussion before the Examiner with regard to the standing orders of Parliament being complied with. The Metropolitan Electric Tramways Co. obtained useful powers in respect to the construction of a new bridge over the Lea at Walthamstow, which will enable the undertaking to be worked with greater convenience, and the Nottinghamshire and Derbyshire Tramways Co. obtained a rectification of an omission in their previous Acts in regard to the compulsory acquisition of land, which has prevented the company from proceeding with the construction of their authorised tramways. The London United Tramways Co. received an extension of time for the acquisition of land and the completion of authorised tramways, and similar powers were granted to the Middlesbrough, Stockton-on-Tees and Thornaby Tramways.

Six electric railway Bills were dealt with, all but one of which related to London. The exception was the Liverpool Overhead Railway Bill, which sought to consolidate its capital powers, and received the required authority. The Metropolitan Railway Co. successfully applied for powers to make various widenings, and also to construct a new railway at Mount Pleasant which will enable the company to cater for the large body of men employed at the Post Office there. The London Electric Railway Co. obtained powers to construct new works at St. Martin-in-the-Fields, which will give better access to other tube railways, and the company was also jointly concerned in the Bill promoted by the Metropolitan District Railway Co. for the creation of a joint Committee to purchase the Lot's Road generating station on terms set forth. Both Bills were carried, as was the Bill of the Central London Railway Co., which, amongst other things, provides for the construction of a line to join the authorised Ealing and Shepherd's Bush line of the Great Western Railway Co., and so give another direct route to the City for the growing Ealing District. The London, Tilbury and Southend Railway Co. obtained authority to raise £750,000 additional capital.

Only two measures dealing with electric lighting companies were promoted, and, curiously enough, whilst one was for the purchase by a local authority of the undertaking of a company, the second was for the purchase by a company of the undertaking of a local authority. The first was the Winchester Corporation Bill, under which the municipality are taking over the undertaking of the Winchester Electric Light and Power Co. on agreed terms, whilst the second related to the acquisition by the Metropolitan Electric Supply Co. of the undertaking of the Acton Urban District Council. The Sidmouth Gas Co. obtained authority to supply electricity, and the Ashbourne Gas Co. power to apply for an electric lighting order. Later in the session one electric power bill was introduced, viz., the East Kent, but it merely dealt with matters of domestic concern.

THE BRITISH ASSOCIATION.—II.

The first business of the Engineering Section on Monday morning (September 4th) was a paper by Mr. Berriman (technical editor of *Flight*) on "The Principles of Flight," at a joint meeting with Section A (Mathematical Sciences). As a matter of fact, engineers and meteorologists did all the talking, and they had a large and appreciative audience. As the paper does not deal with electrical engineering, we do not publish or comment upon it further than to say that the opinion was expressed that many fatal accidents had been due to gyroscopic action of motors and propellers. Mr. Kilburn Scott made the suggestion that a solution of the difficulty would probably be found in building aeroplanes with two engines and two propellers, each pair rotating in opposite directions, with the frames rigidly connected together, so as to keep the shafts always in line.

Radio-telegraphy.—Prof. G. W. O. Howe's paper, entitled "Recent Developments in Radio-telegraphy," an excellent description of the latest improvements, was much appreciated by a large audience. He said that the magnetic detector of the Marconi Co. is ideal in its simplicity and reliability, but is not so sensitive as the electrolytic or the mineral contact detector. The Telefunken Co. has recently, however, given up the electrolytic detector in favour of a mineral contact. It appears that the detector which Prof. Howe uses is simply a piece of zincite in contact with a pencil of pyrites. He finds zincite much better than galena.

An aerial wire, attached to the top of the Portsmouth Town Hall tower by a single telegraph line insulator, was brought in through the window of the lecture room, and exactly at 12 noon the audience heard weather report signals from Norddeich and from Wilhelmshaven, in Germany.

The signals from Norddeich gave a very clear musical note due to the use of Prof. Wien's spark gap. In this spark gap, not only is the spark quenched by an air blast, but the electrodes are comparatively large and the gap short, so that no part of the spark is far removed from a large mass of cold metal. This tends to cool the heated air and condense the metallic vapour, thus lowering the conductivity of the spark, and making it easier to quench.

Captain Riall Sankey then described, with the help of lantern slides, the details of the portable wireless plant of the Marconi Co. The engine and dynamo are carried by one horse, and all that is required, after lifting them to the ground, is a length of flexible shafting to connect across where the horse's body was. Another horse carries the two masts, which can be extended to 60 ft. high. They are placed 350 ft. apart, and a horizontal conductor is stretched between them. Two other horses carry the smaller apparatus, and it is all most ingeniously arranged so that work can be carried on during wet weather, without risk to the insulation, &c. With skilled men the time required to erect all the plant ready for working is 9 minutes, and to dismantle it 6 minutes. The power of the alternator is 400 watts, and the range in mountainous country 20 miles, and over the sea about 100 miles. A more powerful equipment having an alternator of 1,500 watts, and masts 80 ft. high, has a range of 200 miles.

Mr. Kilburn Scott opened the discussion by asking Capt. Sankey whether nitrogen peroxide gas had given any trouble in the enclosed sparking chamber or the aluminium or metal parts. He asked this because when visiting the Marconi factory some time ago there was evidence that a good deal of nitrogen was fixed from the air by the high-tension apparatus. Capt. Sankey was understood to state that a fan was provided to get rid of the gas. Discussing Prof. Howe's paper, he mentioned that a spark lasting one-twentieth of a second would set up a wave that in that time would have traversed 9,500 miles. Regular communication would shortly be established between Coltano, in Italy, and the Argentine, a distance of about 6,000 miles.

Prof. Dalby asked what were the longest and shortest wave lengths in commercial working, and whether an apparatus set for a 2,000-ft. wave length would tune out wave lengths of, say, 2,100 ft. or 1,900 ft. Prof. Howe said the trans-Atlantic service used a wave length of 20,000 ft., whilst the shortest wave length in general use was about 1,000 ft. Ships generally used wave lengths of 1,000 to 2,000 ft. As to how far waves could be tuned out, much depended on the plant at the transmitting station. If it gave a well-sustained wave it was possible to tune out, but the explosions transmitted by some stations, especially those in France, gave some trouble.

Prime Movers.—The papers on "Economical and Reliable Power Generation by Over-type Superheated Steam Engines," by W. J. Marshall; on "Suction Gas Engines and Producers," by W. A. Tookey; and "Diesel Engines," by Chas. Day, were read in abstract and discussed together. Mr. Day rested his case on a table giving average costs per B. of T. unit sold in all the electricity supply stations having a plant capacity not exceeding 1,000 H.P., and having an average load factor of about 15 per cent. These figures are given on page 370 of the Electrical Review, but it may be useful to repeat the total works costs. For steam it is 1·02d., for gas engines 1·04d. and for Diesel engines ·53d. As these are from actual working conditions extending over long periods of time, they are of much greater value than

tests at makers' works or on site. The meeting seemed very much impressed with them, and although Mr. W. Marshall and Mr. Tookey were encouraged by Prof. Biles to upset the impression, they failed to do so, although in reply to Mr. Marshall, Mr. Day did admit that the Diesel engine results were from newer engines than the steam results.

Capt. Riall Sankey gave some useful notes and curves on the determination of "rated output." He mentioned that the Engineering Standards Committee had decided, but not published, that the rated horse-power should be 85 per cent. of what the engine could possibly do. The overload capacity of internal combustion engines was generally lower than for steam engines. Mr. Day stated that his firm usually guaranteed 10 per cent. overload for two hours.

Mr. W. J. Lewis raised the question of utilising exhaust steam, and it was pointed out that as the efficiencies of the three types of engines were 10 to 11 per cent. for steam, 16 to 20 for gas and 40 per cent. for Diesel engines, the more efficient engines naturally gave less possibilities of exhaust heat. For sugar works and paper factories, where there was boiling to be done, the steam system had advantages. At the same time, Mr. Day stated that the exhaust of Diesel engines was being used for heating.

Mr. Kilburn Scott referred to the fact that a leakage in the piping, &c., of a steam engine system could be readily seen; but a leakage of gas could not be seen, and as carbon monoxide was exceedingly poisonous, many cases of gassing had occurred. This was worst in pressure producers, but even suction producers, as he knew by experience, could also give off bad gases. Regarding the viscous oil used for Diesel engines, a leakage was most unlikely to occur, and the oil could be easily stored, whereas coal and coke and the boilers and gas producers in which they were burnt took up much room. He mentioned that at Chichester, only a few miles away, the electricity supply station had Diesel engines, and on his asking the engineer if he had any objections to them, the latter, whose previous experience had all been with steam plant, said that they ran so sweetly that there was nothing to do.

A reference to the limited number of firms who were at present supplying Diesel engines, as compared with steam engine makers, and the relatively higher prices of such engines, brought out the statement from Mr. Day that all essential patents had run out, and that 30 new firms started the manufacture of Diesel engines in Germany last year. Also he had recently been to a Hungarian town for an order, and found that there were five makers of the engines there already.

Mr. Wimperis and Capt. Riall Sankey referred to the possibility of internal combustion engines using both steam and gas.

Mr. H. S. Russell championed the Diesel engines, and Prof. Marchant referred to the omission from the figures quoted of capital costs, which, he said, were frequently half as much again as works costs. They should, therefore, be a leading factor in deciding what type of plant to install.

Nitrogen Products.—On Wednesday morning the first paper was by Mr. E. Kilburn Scott, on "Manufacture of Nitrogen Compounds by Electric Power." The paper was illustrated by lantern slides, and samples of the various nitrogen products mentioned in the paper were shown.

The President of the Association, Sir William Ramsay, opened the discussion. He expressed the opinion that the future of this country lay in the direction of manufacturing such products as the author had described, and that the factories for such manufactures should be established in the neighbourhood of coal mines. He thought the most economical way of using coal was to turn it into gas and by-products and to use the gas for driving engines to generate electricity, which could then be cheaply distributed. This would avoid the cost of long piping to distribute gas, for what we now paid for coal gas was not so much the cost of gas itself as the cost of distributing it. If that were cut down and the gas used economically in large electrical power and chemical works placed in convenient positions for fuel supply, it would be a great relief to the economic conditions of the country. He thought it was a Government question, or possibly one even beyond Government, on which all parties should agree to take expert advice. To his mind there was very little doubt that a policy of that sort would largely lengthen the coal supplies of the country and cheapen our commodities, enabling us also to manufacture electro-chemical and metallurgical products which we now imported.

Dr. Ernest Erkhardt congratulated the author on the way he had dealt fairly with all the various furnaces and methods. As a rule, when an author is interested himself in one or other method, that method is apt to be given undue prominence. He himself was connected with the Badische Anilin und Soda Fabrik, which had established works at Christiansand to make nitric acid and sodium nitrite. As mentioned, this was done by means of the Schonherr furnace. Also it was true that the financial interests controlling the Birkeland-Eyde furnace and the Schonherr furnace had become amalgamated, and a 250,000-H.P. plant was now being built by them at Rjukan. The first 125,000 H.P. would be ready by the middle of next year, and the first of the furnaces were now being set to work. Four-fifths of the furnaces were of the Schonherr type, and the rest were Birkeland-Eyde furnaces.

They would decide on the type to use in the second half from the experience gained with the present plant; much experimenting would, no doubt, be necessary. Regarding the manufacture in this country, he had made inquiries, and could not find any power as cheap as that available in Norway. It was quite true that Great Britain received its supplies very largely from overseas, especially from Chile, but it would be the duty of the Navy to protect the Chile nitrate fleet. If the Navy could not do that, then it could not protect the food supplies, which were even more important.

Sir William White remarked that it was of great advantage to any country to have the means of producing from sources of supply within its own borders anything it wanted. This was especially the case with explosives and other requirements for national defence. He mentioned that when basic steel first came on to the market, making it possible to use the phosphoric ores of this country in place of imported ores, he was one of the first to recognise the national importance of encouraging the new steel, and gave effect to this by specifying it for battleships, &c. He referred to the splendid enterprise shown on the Tyneside, where electric power was being supplied from large power stations for use in electro-chemical factories, ironworks, and shipbuilding yards and collieries. That part of England had fully recognised that the generation and supply of electric power was a business of itself. Many works and mines had closed down quite large power plants of their own because they saw clearly that it was better to buy in bulk from a Power Company experienced in utilising coal economically and which also was in a position to make use of waste heat.

Mr. Wimperis mentioned that it was estimated that over one million horse-power was going to waste in this country in the way of waste gases, which could be made to produce electric power.

Prof. Petavel said that he had tried to improve the percentage of nitric oxide gas formed by the direct process by having the gases under pressure. He found a distinct improvement, but other work took away his attention.

Mr. Haigh wished to know how much of the fixation was due to thermal action, and how much to electrical discharge.

An agricultural expert, Mr. Collins, said that he had experimented with the manures made by the electrical processes, and could speak as to their great value.

In his reply, Mr. Kilburn Scott said that it was hardly fair to hump all the work of looking after us on to the Navy. Where we could easily do so, we should manufacture as much as possible in this country, and certainly explosives ought to be made in their entirety here. If it could not be done by private enterprise, then the Government should step in.

Regarding waste heat stations, as the great advantages became known, the number would increase rapidly, and this was going to have a profound influence on the cheap electric power problem. At the present time, the prices asked for electric power were too high, but we were so accustomed to lavish expenditure on little municipal stations working on low load factors, that it was hardly realised what could be done with economically designed large power plants working on high load factors. The day of the small power station was past. He hoped Prof. Petavel would proceed with his experiments,

as it was quite clear that the one to one and a-half per cent. of nitric acid coming away from the furnaces could be improved upon. Probably by introducing the gases nitrogen and oxygen under high pressure and in exactly the right proportion to combine and not in the proportions in which they were in the atmosphere, there would be marked increase in the output.

As to Mr. Haigh's query, it was evident that the action was not merely thermal, because a silent brush discharge at ordinary temperatures formed nitric oxide gas. A high temperature hastened the chemical combination. The gas had to be suddenly cooled directly it was fixed, and it was to provide for this that the skill of the designer of the furnaces was required. In the calcium cyanamide process this sudden cooling was not necessary.

Smoke.—The next paper was on "Smoke Abatement," by Dr. J. S. Owens. The present legal standard, which says "black smoke in sufficient quantity to be a nuisance," is very unsatisfactory, because *black* smoke is rarely seen; blackness alone is no measure of the amount of the pollution, nor even of the amount of soot per ton of coal burnt. The author suggested that the standard should take account of the density, that is, the amount of soot per unit volume of flue gas. He had devised an instrument to give a fair basis of comparison with a standard density.

Sir William White said that there was a feeling in manufacturing districts that the more smoke there was in the atmosphere, the better the business was. He thought the fines should be substantial.

Mr. Mark L. Sykes, a manufacturer from Leeds, made an amusing speech. He asserted that the best method of preventing black smoke was the prosecution of the rascally manufacturers. Small fines were of no use, so offenders should be kept in gaol until they changed their ways. The only causes of black smoke were the use of bad fuel, careless or stupid stoking, the lack of proper mechanical stokers, and want of proper boiler power.

Screw Transit.—The concluding paper was by Mr. W. Y. Lewis, entitled "Continuous *versus* Intermittent Service in Passenger Transportation." The author and a Mr. Adkins have got out a method of working light passenger coaches on busy lines by means of a continuous screw about 2 ft. in diameter rotating between the rails. The pitch of the thread varies considerably, being about 8 ft. between stations, so as to give 20 to 30 miles an hour, and shorter at the stations, so that the train travels at about 3 miles per hour past the platforms. The author claimed that collisions would be impossible; there would be no signalling; the passengers would be handled in streams, instead of intermittently; the average speed of travel would be higher than at present; labour would be minimised, and power would be low because the system would be regenerative.

Capt. Sankey, who had examined the experimental track at Ransome & Rapier's works, said he was surprised to find that about 80 per cent. of the energy was returned during retardation of the cars.

Prof. Dalby said he had known of the system for several years, and complimented the inventors on the engineering skill put into it.

The Origin and Production of "Corrugation" of Tramway Rails.

By W. Worby Beaumont, M.I.C.E., &c. (*Abstract.*)

Few of the phenomena of the behaviour of materials employed in tramway construction have given rise to so much inquiry, speculation and diversity of opinion in the last few years as the phenomenon known as "corrugation" of tramway rails.

The subject has hitherto been treated mainly from the general point of view suggested by the practical experience of the tramway manager and engineer, and has seldom attracted or received the considered reasoning conjointly of the mechanic and the physicist.

It is, however, one which in a marked degree demands the patient application of the attributes of both, and in this paper I may repeat the words of Mr. H. R. A. Mallock and say, "it is often useful to have a simple, even if incomplete, theoretical treatment of a subject, provided that the theory is correct as far as it goes, and is kept within bounds by comparison with actual observations."

In a surface of a homogeneous solid under compressive stress in orthogonal directions in the plane of the surface, every particle tends to cause every particle surrounding it to recede in every direction.

If one surface of a free flat bar of steel or iron, as fig. 1, be rolled or hammered, the material of that surface is subjected to a compressive stress. Of this stress it is relieved in the direction of length of the bar, so far as the stress is no greater than that which is necessary to bend the bar, and to cause it to keep the bent form of fig. 2.

If of wrought-iron, the molecular surface stress will in part be relieved by flow of the material or detrusion along the edges of the hammered surface, and the longitudinal bending be less than if the bar be of rail steel, in which the detrusion will be less.

If when a bar has been bent by surface compression of one side, it be forcibly straightened, the compressive stress will be increased and a tensile stress impressed on the opposite side sufficient to eliminate the difference of dimensions of the two sides caused by the compression. To remove the difference permanently, the stress on the uncompressed side must reach the character of strain, equally

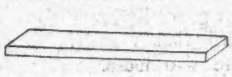


Fig. 1.

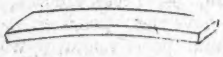


Fig. 2.

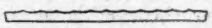


Fig. 3.

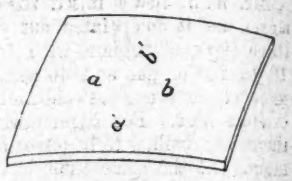


Fig. 4.

distributed throughout the whole length of the bar. At the same time an increase is made in the compressive stress on the rolled or hammered surface. This cannot be relieved by a single pucker or extrusion of the surface about the centre of length of the bar, as the stress is uniformly distributed. Hence at distances apart (or pitch) depending on the elastic and cohesive properties of the material there will result incipient surface crumblings or corrugations, as shown exaggerated in fig. 3.

The bearing of this fact on the tramway or railway rail will appear hereafter, but here it may be observed that a bar which is bent by compression of one side, and caused to retain the bent form by that resident molecular stress, is not in the same condition as to stress throughout its structure as a similar bar bent and maintained in a bent form by mechanically imposed distributed load.

In the bar bent by compression of the material on one side, there is molecular tensile stress immediately below the hammered surface. The compression differentiates in intensity from the surface, to a zone or couche under tensile stress resulting from

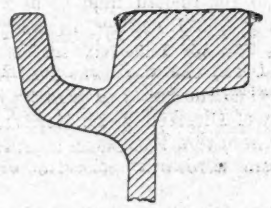


Fig. 5.

the molecular cohesion which has prevented the compressed and extended surface from separating itself by shear. Below this, tensile stress differentiates into a neutral zone, and therefrom into the compressive stress which remains resident in the bar so long as it is bent by these internal forces.

In a surface such as that of an iron plate which has been rolled or hammered on that surface only, the particles of the hammered surface are, as previously mentioned, restrained by cohesion of and with the subjacent particles which are less and less under compression as they are remote from the compressed surface film.

If any two points *a b* or *a' b'*, fig. 4, be taken in such a surface film, it will be seen that all the particles round each point press towards it with forces proportional to some function of their respective distances from such points. In a line drawn from *a* to *b* or *a'* to *b'* there are, therefore, equal and opposite forces tending to separate those points, and when their amount exceeds the elastic resistance of the material, deformation or crushing or crumpling must occur, if change of form of that of which the surface is a part be restrained. If the surface be that of a deformable plate then the forces are in part relieved by bending the plate in orthogonal directions. The distance between *a* and *b* at which any given material will reach the yielding point, or at which the accumulated forces will be sufficient to cause either the bending of a plate, or give rise to destructive stresses in any other form of which the compressed surface is part, will be dependent upon the relation between the elastic resistance of the material to compression and its elastic tensile strength and its hardness.

In dealing with these stresses as occurring in practice, and in such forms as those of a railway or tramway rail, it will be seen from the foregoing that the values of the stresses in orthogonal directions soon reach inequality, because while they become cumulative in the direction of length of the rail, the distance transversely separating the points *a* and *b* earlier reaches the limits of dimensions at which the forces can arise, because relief of the stresses is found in lateral deformation or detrusion at the rail edges. (Fig. 5.)

There is a further view of the physical conditions to be considered, which under the mechanical conditions of the rolling of a

wheel on the plane surface of a rail under pressure greater than or approaching its elastic resistance, gives rise to that which results in what is known as corrugation.

A loaded circular surface as of a roller or wheel, resting upon a deformable straight plane surface, has but a line contact with that surface until either or both the circular and flat surfaces of contact are so deformed by loading the roller as to increase the area of contact. The deformation will continue until the resistance to deformation equals the force producing it. If the materials of the two surfaces be equally resistant, the circular surface will be flattened and the flat surface will be depressed or indented.

If the roller be of the more resistant material the deformation may be chiefly in the material of the flat surface. If the roller be made to roll along the surface which it can so deform, it presses before it a wave of deformation. The depression giving rise to this wave may (as in the case of the tramcar wheels and rails) approach or exceed the limit of elastic deformation of the material of the rail. When this is the case, continuation of the movement of the roller upon the surface demands the translation of the crest of the wave, and this would involve the destruction of the cohesion between the

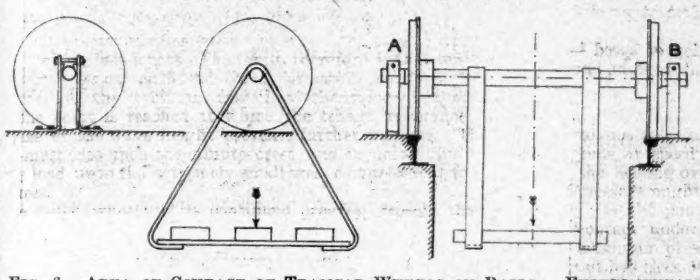
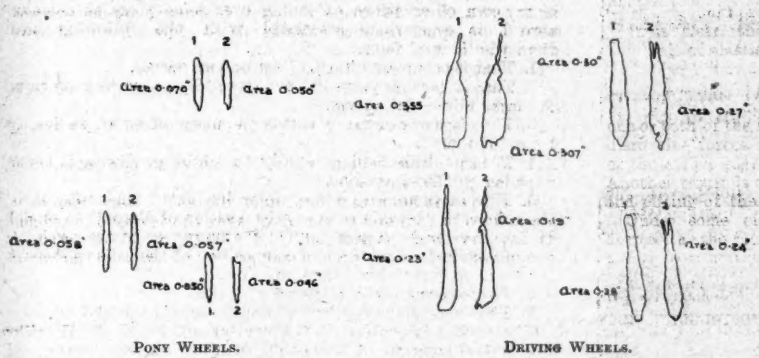


Fig. 6.—Area of Contact of Tramcar Wheels on Rails. Experimental Apparatus.



Pony Wheels.				Driving Wheels.			
A		B		A		B	
0·070	Average of 8	0·050		0·355	Average of 4	0·307	
0·058		0·057		0·300		0·190	
0·050		0·046		0·230		0·270	
3)0·178		3) 153		0·280		0·240	
Average = 0·059		0·051		4)1·165		4)1·007	
				Average = 0·291		0·251	

Diameter of wheels, 21⅜ in.
Load on axle, 3½ tons.
Average load over area of contact, 31·8 tons per sq. in. (static load).

Diameter of wheels at A, 31 in.
" at B, 31½ in.
Load on axle, 6 tons.
Average load over area of contact, 11·96 tons per sq. in.

Fig. 7.—Diagrams of Contact Areas.

rolled compressed surface wave-crest and the material supporting it and of which it is a part. The result, therefore, is that tensile stress arises *pari passu* with the wave formation between the wave particle and the subjacent particle of the material supporting it, and the point is reached at which the tensile resistance to the increase of the wave height prevents further increase. The roller then must rise upon the minute crest, and in doing this with its heavy load upon the extremely small area, compresses it to extreme hardness.

The roller (wheel) in its continued progress repeats the process and continuously adds to the rearward dimensions of the hardened spot.

The foregoing then shows that the rolling and hammering of the upper surfaces of a rail originates a condition of intense compressive stress, the elimination of which produces, or tends to produce, modification of form. It also shows that areas of maximum compression are originated at points separated by distances which are determined mainly by the relation between compression, resistance and elastic strength of the material rolled, but in part by the relative hardness of the roller and rail, and by the mechanical conditions which affect the area of the roller and rail contact.

The area of contact of hard tire tramway wheels on steel rails is very small, is less than on ordinary railway wheels. On the latter it has been found to vary, with wheels 4 ft. 6 in. to 5 ft. in diameter and carrying a steadily applied static load of from 12,000 to 14,000 lb. per wheel, from 66,000 to 48,000 lb. per sq. in. of contact area. The minimum and maximum areas of a larger number of observations gave loads per square inch of contact area of from 26,607 to 85,961 lb. The former, however, was the minimum pressure, as it was taken with an engine standing on a level rail, and the wheel gently lowered on to it. With an engine moving at speed, and heeling over as on curves, this pressure would be much greater. It must further be noted that the central part of the area of contact would be much more severely pressed than the borders of the area.

By the courtesy of Mr. A. L. C. Fell, M.I.E.E., the author has been enabled to give measurements, made at his request, of the pressure of the wheels of a standing car on clean rails of standard type. These measurements were made by loading the axles of the larger and the smaller wheels of the bogie of one of the large standard London County Council double bogie trucks.

For the purpose of the experiments a sling was made, as shown on the sketch, fig. 6; this consisted of flat bars, to which were bolted three pieces of timber, on which the load was placed.

The rails were carefully cleaned and the wheels turned to the correct standard taper, but with a finer cut than that usually adopted in practice. The rails showed very little sign of wear, and the experiments were made at the end of a shop which had not been very much used.

The load used was as follows in each case:—Driving wheels, 31 in. diam., 6 tons; pony wheels, 21·56 in. diam., 3·25 tons. These weights approximate closely to the actual weights on a standard bogie car when loaded.

The wheel on the side marked "A," see fig. 6, was on the rail where it was continuously supported. On the side marked "B" the wheel rested immediately above the centre of a pier 14 in. wide, where the rail was not quite so rigidly carried. The diagrams obtained, marked 1 (fig. 7), were slightly larger on this side.

At each end of the axle a guide bracket was fixed to the ground, as shown on the sketch; between these brackets and the axle journal taper pieces of wood were fixed to prevent lateral movement.

The axle was lifted at the extreme end by means of a jack and lowered carefully on a piece of tissue paper on thin carbon paper placed on the rail under the wheel. The impressions made are shown by the diagrams herewith, fig. 7.

The rails were of British standard hardness, and the tires were manufactured to the specification, for the following extract from which the author is indebted to Mr. Fell:—

Tensile strength not less than 55 and not more than 70 tons per square inch—minimum elongation of 11 per cent. to 8 per cent. in 2 in., and of the following composition:—

Carbon	...	0·65 to 0·75 per cent.
Silicon	...	0·32 "
Manganese	...	0·6 to 0·8 "
Sulphur	...	0·035 "
Phosphorus	...	0·035 "

The tires are thus of harder material than the rails, which have 0·40 to 0·55 per cent. carbon.

The areas of contact carefully measured from these diagrams are given in fig. 7, the areas and pressures given being those obtained from the smaller diagrams marked 2, measured on the inner edge of the black lines made by the carbon paper.

The loads given per square inch are the average loads over the whole area of the diagram when the tire had pressed into the rail and the tire itself also microscopically deformed until the area of support given was obtained. The pressure per unit of area in the centre of the area of support would, of course, enormously exceed this average, and I estimate the maximum static pressure to be not less than 35 tons per square inch under the driving wheels. When the car is running at ordinary speed the pressure would rise to not less than double this as impact pressure, and when the car runs at speed round curves, and the greater part of the load with the heeling over of the car is visited on the wheels on one side, the pressure might easily reach at least 100 tons per sq. in.

On the pony wheels the average pressure of the whole area of contact under static loads reached 31·8 tons per sq. in. The maximum pressure in the centre of area of contact was probably not less than 50 tons. This with the car running at ordinary speeds would probably reach 90 tons per sq. in., and when running at speed round curves, and the car heeling over so that the greater part of the load rested on the wheels on one side, the maximum pressure would probably reach 120 tons per sq. in.

It is clear, then, that the pressure per unit of area exceeds the limit of elastic compression of the material of the average rail, and that flow or deformation would occur were it not that the area pressed is supported by the surrounding material and held *encastrée*, so that flow cannot occur. One result of this is the detrusion of one or both of the rail edges, as shown by fig. 5, by which cumulative disruptive forces are in part dissipated, and the extruded material on the groove edge of the tread is removed by the car wheel flanges. Another result is corrugation, and a third is the minute crumbling and pitting of the rolled surface.

Under some circumstances and conditions corrugations may decrease as the raised hardened surfaces approach by lengthening, and as corrugation and the surface become more uniform by the

removal of surface material by crumbling or minute flaking, especially of the harder rails with up to 0·66 of carbon, which best resist the causes of corrugation. The removal of corrugations, however, by grinding only prepares the rail surface for quick recommencement of corrugation or for lengthening the hardened part of the corrugations.

If the preceding be accepted as the origin and production of corrugation, then the question remains, What are the remedies?

The mechanical originating conditions being the weight on the wheels and the increase of that weight, more especially on outside curves by car heeling at the higher speeds, then:—

The first and most effective remedy is the reduction of the great destructive weight on the wheels of the modern car.

The second is the use of larger wheels than can be used with the present design of car.

The third is the maintenance of moderate speeds; of much lower speeds than are common on curves, even those of large radius, and moderate speeds on lines that may be classed as straight, but which have such departure from straightness, horizontal and vertical, as will encourage boxing or wandering of the cars from side to side.

Fourthly, the use of harder rails than the hardest at present employed.

The reduction of weight is possible, the reduction of speed is possible, the use of larger wheels is possible with future cars, and

FIG. 8.—RAIL OF LEEDS CITY TRAMWAYS.—HORSFORTH.

Opposite pole 204.	Up gradient, 1 in 50.
Incoming track.	Pitch of corrugations, 2½ in.
Inner rail.	In use four years.
Straight track	B.S.S. No. 4.

the use of harder or more resistant rail materials may be possible but they would have to be produced by methods more costly than those now adopted.

The remedies will involve modifications in the views at present prevalent as to the place, purpose and working of tramway services, but even the most ardent advocates of tramway ubiquity will ultimately be constrained to admit that tramways, like all other things that have and offer desirable ends and convenience, have also their economic and expediency limits.

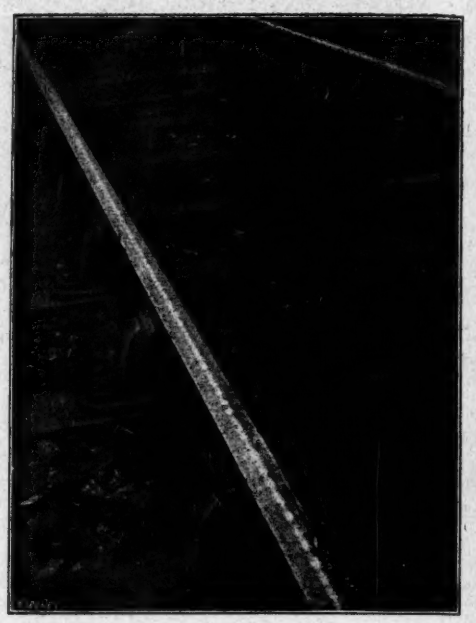


FIG. 9.—RAILWAY RAIL.

The occurrence of corrugation of electric tramway rails as recorded by many tramway engineers and managers, and as found by my own observations extending over some years at home and abroad, is everywhere associated with the following broad generalisations of facts.

1. That it occurs on straight lines and on curves.
2. That it is most prevalent and generally commences on curves of large radius—flat curves.
3. That it never or rarely occurs on curves of small radius, *e.g.*, from 40 to 80 ft.
4. That on hills, and especially on slight gradients, it is most prevalent on the down line.
5. That its occurrence as to date or length of time after laying the rails varies broadly with (*a*) the position of the rail on straight or flat curve or down gradient, (*b*) the frequency of the service, (*c*) the mechanical properties and composition of the rails as shown by more or less outer edge detrusion.
6. That it occurs with all types of truck.
7. That it is most prevalent where the speeds are highest.

The author is enabled by the courtesy of Mr. J B. Hamilton, the general manager of the Leeds Tramway, to show photographs of rails in that city (fig. 8).

A small photograph is also exhibited of a rail in a straight piece of track on the Midland Railway, Sheffield, on a falling gradient of 1 in 100 (fig. 9). This shows a much worn rail with the bright hard spots about the centre of the tread, and shows that what is called corrugation is not confined as to the nature of origin or production to street tramway rails, although it is necessarily much more general and severe on tramways and other rails where heavy vehicles with small wheels and high speeds are used, as, for example, on some of our tube lines and the Metropolitan of Paris.

Recent Developments in Radio-Telegraphy.

By PROF. G. W. O. HOWE. (*Abstract.*)

THE principal cause of the difficulties experienced to-day in maintaining satisfactory communication by means of radio-telegraphy is to be found in the phenomenal growth of this means of transmitting intelligence. The difficulties are mainly due to interference between different stations working simultaneously. Formerly the only disturbance was that due to atmospheric influences, but these are now becoming of less comparative importance, due to the great multiplication of radio-telegraphic equipments and the increasing power used in their sending apparatus. These difficulties promise to increase steadily in the future, and it is therefore a matter of some importance that we should consider the recent developments in the apparatus employed and in the principles involved.

Nearly all the developments, both in the sending and in the receiving apparatus, have had as their objective the decrease in the interference caused to, or suffered from, other stations. This is, at the present moment, of far greater importance than efficiency or even reliability.

Since the earliest experiments in radio-telegraphy, it has been sought to decrease the decrement of the train of waves which accompanies each spark. The sending apparatus in common use at the present day differs, however, but little in principle from that used with the earliest coupled aerials. The spark-gap is either stationary and provided with a powerful air-blast or the electrodes are rotated at a high speed, thus causing movement of the air, and at the same time bringing cold metal surfaces to act as electrodes. The production of undamped or slightly damped trains of waves by means of Poulsen or Lepel arcs has not made the revolution in radio-

telegraphy which was predicted, while the quenched spark between plane metal surfaces a fraction of a millimetre apart falls far short of the long open gap in reliability. The unquenched long gap necessitates very loose coupling, and therefore very low efficiency if beats in the emitted waves are to be avoided. If the coupling is made tighter than about 5 per cent., undue interference with other stations will probably ensue.

A great improvement has taken place in the nature of the note sent out by most large stations. In the earlier arrangements the sparks followed each other so irregularly, or the spark frequency was so low, that the signal heard in the telephone was nothing more than a crackling noise, very similar to, and easily confounded with, the noises due to atmospheric disturbances. It is not essential to tune out all other signals and extraneous noises, if the signals which have to be received have a distinctive musical note. This has led to the frequency being increased from 10 or 20 to 500 or 1,000 sparks per second. The difficulty of getting, with any regularity, 1,000 sparks per second with an ordinary gap and a power of several kilowatts will be apparent. If the use of a certain note became general, much of its advantage would be gone, but it would still be a great improvement in combatting atmospherics.

Although the receiving arrangements have been made very convenient for rapid tuning, no radical change has been made in the detectors employed. One has still to choose between reliability and sensitiveness. If extreme sensitiveness is not desired, the magnetic detector is ideal in its simplicity. For the reception of weak signals we have the Fleming valve, the electrolytic and various crystal detectors, if necessary, in conjunction with the Brown telephone relay. Attempts have been made to obtain selective working by tuning the reed of the relay, but the general utility of the station so equipped would be greatly reduced, to say nothing of the adjustment and manipulation required.

Experiments for Improving the Construction of Practical Standards for Electrical Measurements.

Report of the Committee, consisting of Lord Rayleigh (Chairman), Dr. R. T. Glazebrook (Secretary), Professors J. Perry, W. G. Adams, and G. Carey Foster, Sir Oliver Lodge, Dr. A. Muirhead, Sir W. H. Preece, Professors A. Schuster, J. A. Fleming, and Sir J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Professor S. P. Thompson, Mr. J. Rennie, Principal E. H. Griffiths, Sir Arthur Rucker, Professor H. L. Callendar, and Messrs. G. Matthey, A. P. Trotter, T. Mather, and F. E. Smith.

The Committee have to regret the death, since the last meeting of the Association, of Dr. G. Johnstone Stoney, F.R.S. He had been a member since 1861, and up to a few years since continued his active interest in the work. In its earlier stages his skill in definition and his admirable choice of nomenclature had proved invaluable to the Committee. The collected Reports, which are to be issued shortly, will indicate how large a share in the establishment of the C.G.S. system of units is due to him.

Republication of Reports.—The republication of the Reports is not yet completed, but this should be done within the present year. The proofs of the Reports from 1862 to 1883 have been finally revised, and the remaining proofs will soon be ready.

Lorenz Apparatus.—The progress made has been satisfactory. Preliminary experiments have shown that the apparatus is uninfluenced by changes in the earth's magnetic field, and that the thermal E.M.F.s at the brushes on the two disks very nearly balance. With the form of brush in use at present there are sudden changes in the difference of the thermal E.M.F. amounting to 2×10^{-7} volt, and it may be difficult entirely to eliminate these. With other forms of brushes, *e.g.*, those made of gauze, the difference was often 1,000 times as great. It was this difficulty which led Lord Rayleigh in 1883 to amalgamate the edge of the disk, and as a further improvement Prof. Viriamu Jones and Prof. Ayrton used mercury jets instead of brushes. Since in the present apparatus the changes are only 1 in 10,000 of the difference of potential produced in one arrangement of the brushes and less for a second arrangement, it is hoped that mercury contacts will not be necessary. Further experiments will be made in order to obtain greater perfection, if such is possible.

Resistance Standards.—The construction of new mercury standards of resistance in accordance with the specification of the London Conference is being proceeded with, and some of the standards will be completed this year. Similar work is in progress in France, in Germany, in Austria, and in the United States. In the latter country four standards have had all of their constants determined, and the resistance unit so obtained is in very close agreement with that obtained from the old National Physical Laboratory standards.

In the Committee's Report for 1908 it was shown that many manganin resistance coils—some of which were purchased by the Committee in 1895—were very changeable in resistance, and in consequence frequent comparison with mercury standards was necessary. In 1908 it was shown at the Bureau of Standards, and confirmed at the National Physical Laboratory and at the Reichsanstalt, that these changes were largely due to the effect of moisture on the shellac covering the wire. To eliminate this source of trouble, many of the coils were hermetically sealed in 1909, and it is satisfactory to record that they are now much more constant. The importance of this hermetical sealing is so great when manganin resistances are to be sent to such places as cable stations in the tropics, that the attention of instrument manufacturers is drawn to the matter. Standard coils are readily sealed, and boxes of coils may be sealed in metal cases. The following figures for standard coils of manganin show the advantage of hermetical sealing :—

Nominal value ...		100 ohms		1,000 ohms	10,000 ohms
—		No. 2,450	No. 740	No. 2,449	No. 2,448
Open coils	Oct. 1903	99·995$_9$	1,000·15$_3$	1,000·01$_2$	10,000·2$_4$
	1904	100·000$_3$	·17$_2$	·24$_4$	2·4$_0$
	1905	·004$_8$	·21$_8$	·49$_4$	3·5$_7$
	1906	·009$_2$	·24$_8$	·66$_9$	3·8$_3$
	1907	·013$_3$	·26$_8$	·81$_4$	3·7$_4$
	1908	·028$_8$	·30$_2$	1·13$_0$	3·8$_5$
Hermetically sealed in paraffin oil	June 1909	·036$_9$	·36$_5$	1·04$_6$	5·5$_8$
	1910	·038$_4$	·35$_7$	1·07$_5$	5·5$_5$
	1911	·039$_9$	·35$_9$	1·06$_9$	5·6$_1$

It will be noted that the changes during the last three years are very small.

Silver Voltameter and Standard Cell.—Although the actions which take place when a current passes through a solution of silver nitrate as in a silver voltameter are now well understood, the effects of septa—such as silk, filter paper, and porous porcelain—are by no means clear, and experiments have, therefore, been made to decide whether any septum at all should be used in a voltameter. Such experiments were suggested at the Washington meeting in 1910. The results of the experiments made at the National Physical Laboratory indicate that a septum of any kind is usually a source of trouble, and may produce secondary reactions during the electrolysis which affect the weight of the silver deposit. Fortunately, voltameters have been designed which render a septum unnecessary, and these may be useful, not only in precise current measurements with the silver voltameter, but for the deposition of metals other than silver.

The reproducibility and constancy of the Western normal cell are still being carefully examined. The chief anomaly is the hysteresis effect mentioned in last year's Report: for this effect we have no explanation although one is much needed, as probably it would enable cells to be made so as to remain even more constant in E.M.F. than at present. It is necessary to point out that while the effect is called a hysteresis one, the E.M.F. does not lag behind the temperature. Briefly put, with ascending temperatures the E.M.F. changes in close agreement with the temperature—E.M.F. formula, but with descending temperatures the E.M.F. changes too rapidly, corresponding to values at temperatures lower than the temperature of the cell, by from 3° to 15°.

The Committee had hoped to have made this their last Report, but in view of the fact that the republication is not complete they ask for reappointment, with Lord Rayleigh as chairman and Dr. R. T. Glazebrook as secretary.

The Present Position of Electric Steel Melting.

Report by Prof. Andrew McWilliam, A.R.S.M., M.Met.

Section B. (*Abstract.*)

The melting of steel by means of electricity has passed the merely experimental stage and become one of the commercial processes by means of which steel is manufactured for the market. The general impression gathered from much conversation with users is that the arc furnace product from slightly impure materials, purified to Swedish standard, just about takes its place by Swedish open-hearth and Bessemer steels, and that the induction furnace product skilfully made from pure materials equals anything but the very highest qualities of crucible steels. The special feature of the Héroult and Röchling-Rodenhauser types is that with an oxidising purification phosphorus can be eliminated to almost any extent that will pay, and after removing the slag, and forming another, by a reducing purification sulphur can similarly be removed.

The Kjellin induction furnace acts as a melter of materials much after the manner of the crucible, and has one advantage over the crucible in that there is no absorption of sulphur during melting. Recent experiments with covering slags specially calculated by the writer to give a minimum of change in composition during melting, show compositions in the ingots practically equal to those by calculation from the constituents. One fact must never be forgotten: the electric furnace of whatever design will not make good steel automatically. The same metallurgical skill required by the older processes must be expended on the proper killing and finishing of the steel, by whatever type of electric furnace it is being melted, and the fact that in electric as in other furnaces bad steel may be made from good materials, increases the difficulties of finding the exact place of any steel in the world's work. Several cases where the electric steel has been found unsuitable, especially in the earlier days, have been investigated, and it has been found that the steel has been wrongly made. In other cases no such explanation could be given.

One point of importance is that this production of electric steel has introduced a new competitor into the field by giving great impetus to the use of the large waterfalls, mostly far removed

from coal, and much energy is now being used that formerly ran to waste, whilst the successful application of electric power to the production of charcoal pig-iron allows of a much-reduced consumption of charcoal. The rapidly increasing price of charcoal in Sweden is quite a serious situation which this application of electric power may help to relieve.

The Stassano furnace is an independent arc furnace, with three carbon electrodes. The Héroult steel-melting furnace is a direct arc type, in which the charge forms one pole of the arc. The Girod furnace is a direct arc furnace, but one or more electrodes of like polarity are maintained above the bath, and soft steel pieces embedded in the hearth of the furnace are in direct contact with the molten metal for the negative electrode. These lower pole-pieces are water-cooled. Large quantities of ferro-silicon, ferro-chrome, &c., as well as of ordinary carbon and special steels are made in this furnace. The Keller steel furnace is a direct arc furnace, very much like the Héroult. The Grönwall is of the arc type; the current enters by two electrodes through the roof, and when once the bath is heated so that the lining becomes a conductor the current from both electrodes passes through the lining to a graphite block underneath, and hence to a common wire. The Nathusius, like the Grönwall, is a combined arc and resistance furnace.

In the Kjellin induction furnace the metal charge is placed in an annular hearth, and the primary coil of 24 turns is placed in the centre round a core of laminated iron. The bath or ring of metal acts as a secondary circuit of a single turn, and the heat is thus produced in the charge itself without contact with electrodes.

The Röchling-Rodenhauser furnace is based on the Kjellin principle but has an important addition. In its simplest form for single-phase current there are two grooves or heating channels corresponding to the annular crucible of the Kjellin, but these join to a central open-hearth, the whole hearth forming a kind of figure 8. In the central open-hearth all the distinctly metallurgical operations take place, so that this form can be used for refining work for which the Kjellin is not very suitable. Not only so, but a distinct secondary winding is provided in which a secondary current is induced, and these windings are joined to steel terminal plates which are embedded in the refractory material of the furnace at the ends of the central hearth. At high temperatures the refractory material becomes a conductor of electricity and thus the currents induced pass through the bath in the central hearth, heating it still further.

There are many others, some only on paper, but these are the principal varieties that have been tried with any considerable degree of success. The loss in melting is an important point, and I am informed that this amounts to about 1½ per cent. in the Kjellin, about 4 to 5 in the Röchling-Rodenhauser, and 7 to 8 per cent. in arc furnaces.

So far as one could ascertain, about June, 1910, there were about 118 furnaces of all types, of which 70 were in use, 10 not working, and 38 being built. There were 77 of the arc furnaces recorded, of which 29 were credited as Héroult, 17 Girod, 13 Stassano, 6 Keller and 9 others; besides one furnace at Domnarfvet, Sweden, for the production of 2,500 tons of pig-iron per annum, with one in Norway and one at Trollhättan, Sweden, both in course of construction and each designed to produce about 7,500 tons of pig-iron annually. Of the Héroult furnaces the total capacity per charge of those working was about 80 tons and of those in course of construction about 50 tons. The Girod furnaces, the great competitors of the Héroult, were recorded at about 38 tons in work and 26 tons being built. Similarly the figures for the Keller were 13 tons and 5 tons, and for the others 20 tons and 13 tons respectively.

Of the induction furnaces the Kjellin furnaces erected totalled 14 with 35 tons capacity, the Röchling-Rodenhauser 15, with 30 tons in work, 1 ton not in work, and 17 tons capacity being built, all others about 18 tons in work. That gave a total capacity of about 250 tons for the arc furnaces and 100 tons for the induction, or a grand total of 350 tons per charge for all electric steel-melting furnaces. About June, 1911, there were 43 Héroult furnaces, with a total capacity of 242 tons.

The output of electric steel in Germany, the United States and Austria-Hungary in 1910 amounted to almost 112,000 tons, which is an increase of 63,000 tons over the figures for 1909. These are the only countries for which the exact output of electric steel is published, but there is no doubt that the figures for Sweden, France, Belgium and Italy would also show large gains. The increase will probably be more than maintained in 1911, as more than 30 new furnaces of various types should be started during the year, and many which only started towards the end of 1910 will put in a full year's work in 1911. England will also for the first time appear as a regular producer. Before the beginning of the present year the Héroult furnace at Edgar Allen's, in Sheffield, was the only arc one in steady operation. In January three Héroult furnaces were commenced in England, at Vickers, and Thos. Firth and Sons, in Sheffield, and at Lake & Elliott's, in Braintree, Essex. A Grönwall furnace, for demonstration and manufacturing purposes, also started at about the same time in Sheffield, and the output of England for 1911 should amount to about 13,000 tons. A 15-ton Héroult furnace is to be erected at Skinningrove shortly, and is expected to turn out 200 tons per day. About the same period Kjellin induction furnaces have been working satisfactorily at Vickers & Jessop's, in Sheffield, and an experimental furnace at the University of Sheffield.

Great progress will be made in Germany with electric furnaces during the next year, when Héroult furnaces of 25 and 22 tons capacity are to be constructed. At present the largest size are the two 15-ton Héroult furnaces at South Chicago and Worcester, belonging to the United States Steel Corporation, who have recently acquired the Héroult patents for America, and will probably erect several more furnaces shortly.

The electric furnace can be used either for melting scrap directly or in combination with some other form of furnace, in which case it simply acts as a refiner. The majority of the recent furnaces have been employed in this way, in conjunction either with Bessemer or open-hearth furnaces. The latter are usually of the basic tilting type, part of the charge being removed to the electric furnace after the pig is melted and the bulk of the phosphorus removed, leaving some phosphorus and the oxygen and sulphur to be eliminated by the electric furnace. In this case the time required for the electric furnace is from one hour to two hours, according to the degree of refining required and the original condition of the steel when removed from the basic furnace. The energy used varies from 100 to 300 KW.-hours per ton. When cold scrap is melted the time required is about six hours, and the energy consumption is said to be from 650 to 750 KW.-hours; but really, all told, more probably 800 to 1,000 per ton. Of the 44 Héroult furnaces in operation or construction, 21 are to melt scrap, 20 to take molten steel from the basic open-hearth, one from a Talbot furnace and two from converters.

Electric furnaces are being employed in the following cases:—

1. To replace crucibles. The gain is then one of cost of production.

2. For foundries. Electric furnaces are being used in many foundries. At Georg Fischer's & Schaffhausen they are the only furnaces employed, and Lake & Elliott, of Braintree, are now making most of their steel electrically.

3. To replace Swedish Bessemer steel, and for steel of axle and tire quality.

4. For weldless tubes. The Mannesmann Co. have Héroult furnaces in Germany and Italy.

5. In combination with Talbot furnaces. Owing to the fact that the heat need not be sufficiently great for teeming on transference to the electric furnace, the output of the Talbot, and the life of the lining and roof are said to be largely increased. This will be the procedure at Skinningrove for making rails.

6. For melting turnings, especially high-speed turnings. These make excellent scrap for the electric furnace. Nickel scrap can be melted without any loss of nickel.

Tables are given in the paper representing the furnaces, capacities and kind of work done by all the furnaces under the care of the two principal firms already named. The Kjellin furnace has been adopted for melting the metal for the manufacture of culinary vessels of pure nickel.

PROCEEDINGS OF INSTITUTIONS.

Some New Types of Dynamometers.

By Dr. Alfred Amsler, Schaffhausen.

(*Abstract of paper read at the Swiss Meeting of the* Institution of Mechanical Engineers, 1911.)

The author deals with two types of transmission dynamometers, constructed by his own firm, the one type—the torsion dynamometer—being designed for measuring the power transmitted to or from high-speed machines, where the torque is fairly constant and therefore need not be recorded in a diagram; the other type—the hydraulic dynamometer—being intended to be used for measuring and recording the energy absorbed by slow-running machines of variable resistance.

Fig. 1 illustrates a dynamometer which couples the shaft of the driving engine direct to the driven machine. The two shaft ends are coupled together by means of the shaft G; this shaft has therefore to transmit the entire power from one machine to the other, and is subjected to torsion, the angle through which the opposite ends are turned being proportional to the twisting moment, and to the power transmitted. If the shaft is made of a special spring steel of very high yield-point, that is, above 6,000 kg. per square centimetre (90,000 lb. per square in.), it can be twisted to a considerable degree without breakage or permanent distortion. For example, in the example shown in fig. 1 the twist of the rod 40 cm. long is for a twisting moment of 20 mkg. (1,736 in.-lb.) about 20°. The shaft has a cross-section of 12 by 12 mm., and is, therefore, subjected to a stress of 5,200 kg. per sq. centimetre (78,000 lb. per sq. in.), which is well below the yield-point. The various parts attached to the shaft G serve partly for indicating its angle of twist and partly to prevent it from being twisted excessively, so that it cannot be overloaded.

For reading the angle of twist, three disks M, N and O are used. M is fixed firmly to the end H of the shaft, N and O are fixed firmly to the end F of the shaft. The disk O is provided with a radial slit P. To the disk M a transparent rim U made of celluloid is fixed, on which the divisions are cut. Opposite to the slit P a small window has been cut out in the disk N and is provided with a fine slit T.

When the eye Q looks through the slit P the slit T will be seen as a streak of light and the divisions will show black on the scale U. The slit T serves as a pointer for indicating the relative motion of the two disks N and O as compared to the disk M. The line of vision is perfectly defined by the two slits P and T; parallax is, therefore, impossible when reading the scale, and the observation is therefore independent of the distance between the scale U and the slit T.

When the apparatus is stationary it will be clear that, if the shaft is twisted, the angle of twist will be shown by the movement of the pointer T over the division U. But this pointer and division will also be visible when the instrument is running, in fact it will be clearer and more defined than when the instrument is at rest, for whilst it is necessary to place the eye close to the slit P when the instrument is at rest in order to be able to see the pointer and the scale, it is possible when the instrument is in motion to read the scale at some distance from the slit P. The greater this distance is, the more the scale will appear to be enlarged; this enlargement, it should be stated, is independent of the speed. The reason why the scale is still seen when the machine is running is due to the following: The eye looking at the scale through the slit P sees the pointer and scale once for every revolution, and this only during the very short time when the small slit P is passing before the eye; the light impression is, therefore, instantaneous. One of these impressions would be too small to leave a permanent image in the eye, but since a number of impressions is given to the eye in rapid succession, namely, once at each revolution of the disk, the eye appears to receive a continuous stationary image of the pointer. Should the machine work at a speed below 250 R.P.M. these images are not continuous, and the reading of the divisions becomes cumbersome, but still possible.

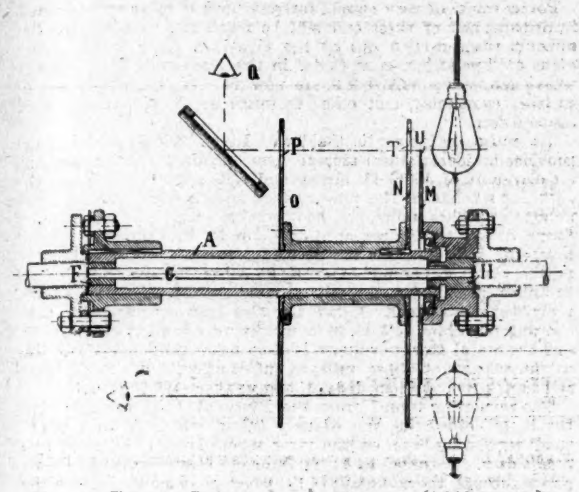


FIG. 1.—TORSION DYNAMOMETER, 50 M.-KG. (4,340 IN.-LB.)

In order to obtain a permanent impression on the eye, the scale must be subjected to a strong light. The short period of observation must be strengthened by the intensity of the light, since a fixed minimum amount of light energy, that is, intensity multiplied by duration, is required to affect the optic nerve. A 50-C.P. lamp provided with a ground glazed globe suffices for illuminating the scale, and should be placed as close as possible behind the disk M. Instead of looking at the slit P direct, it will be found better to insert a mirror so that the scale can be observed from the side, as shown in fig. 1. In order that the eye be not dazzled by other light, the daylight should be screened off.

The observations can be best carried out in a dark room, and only one eye should be used. The angle of torque observed shows the twist-strain in the shaft, since the slit P passes the eye at regular intervals.

Since the shaft and the other parts which are connected to its extremities have no tendency to move, due to centrifugal force, the readings of the dynamometer are independent of the speed. The instrument can, therefore, be run at any speed desired, provided, of course, no forces are set up greater than can be resisted by the material of which the disks M, N and O are made. The instrument is made generally for high speeds of about 4,500 R.P.M., but some instruments have already been made for speeds of 7,000 and even 8,500 R.P.M. The coefficient of elasticity of the shaft can be determined when at rest by fixing a lever of known length at one end and loading this with weights.

The largest instrument at present made can measure torques up to 1,500 mkg. (130,200 in.-lb.) and the smallest up to 8 mkg. (694 in.-lb.). The instrument suffers from but one defect, namely, the air-resistance of the rotating parts, but the influence of the air is very small, especially when the dynamometer is so inserted that the disk M is placed nearest to the machine, the power of which is to be measured. The instrument can be run in either direction without any alteration having to be made.

The hydraulic type of dynamometer, which is used for measuring and recording the power absorbed by machines subjected to a variable load, is driven from the engine by means of a belt, and transmits the power by means of a second belt to the driven machine. The driving and driven pulleys are connected by cylinders filled with oil and pistons exerting a pressure on the oil. This oil-pressure is transmitted through a hollow shaft to a fixed casing, to which on one side a pressure-gauge is fixed and on another side the recording apparatus. The pressure-gauge indicates the torque with which one pulley drives the other.

This dynamometer is not nearly so simple and does not indicate the power as directly as the torsion dynamometer; it is consequently less accurate and needs watching. On the other hand, measurements can be made which are impossible to obtain with the torsion dynamometer—namely, the power is continuously recorded on a strip of paper, and can be accurately determined, however much it may vary.

Experiments with Turbines.

By PROF. DR. FRANZ PRASIL, Zurich.

(Abstract of paper read at the Swiss Meeting of the INSTITUTION OF MECHANICAL ENGINEERS, 1911.)

IN this paper the author gives particulars of the methods and results of a series of tests on Francis and Pelton turbines, made by four firms not named. He remarks on the enormous sizes which have been attained since 1900, as high as 16,000 H.P. per wheel, and states that the limits of attainable dynamic efficiency and perfection in governing have nearly been reached. The Francis turbine is used for falls from 1 to 150 m. (3·3 to 492 ft.), and the Pelton wheel for falls of 40 to 950 m. (131 to 3,116 ft.)

In most of the open Francis turbines tested, the maximum efficiency was reached between 70 and 80 per cent. of full load, and in all four cases the efficiency was over 85 per cent. at about 80 per cent. of full load. The highest efficiency observed was 88·6 per cent. These turbines were tested on falls of 4·4 to 10·4 m., at 100 to 160 R.P.M., with outputs of 158 to 1,250 H.P. at full gate.

Greater differences were found between the turbines with closed spiral wheel cases; the maximum efficiency was reached between 80 and 90 per cent. of full load, and ranged from 79·6 to 87·6 per cent. The outputs of four turbines of this class were between 2,620 and 4,000 H.P., the head of water being from 60 to 147 m., and the speed 400 to 601 R.P.M. The largest turbine was tested only to ⅔ full gate.

Governing tests were also made on two of the latter class of turbines, fitted with oil relay-motors; one, provided with a heavy fly-wheel, showed about 6 per cent. maximum variation from normal speed with a change of load of 1,800 KW. (normal full load 2,696 H.P.), while the other, without special fly-wheel, showed variations up to 18 per cent. with 2,100 KW. thrown off (normal full load 3,458 H.P.).

Four Pelton wheels were tested, and showed efficiencies between 84 and 85 per cent. at 55 per cent. of full load; with one exception, all showed efficiencies between 83·5 and 88·9 per cent. at full load, and one reached 89·3 per cent. at ¾ full load. The efficiency was maintained above 80 per cent. in all cases down to 30 per cent. of full load. The head varied from 90 to 850 m., the speed from 180 to 630 R.P.M., and the output from 300 to 6,050 H.P., the results showing remarkable uniformity, in spite of these wide differences. All were fitted with needle nozzles controlled by governors, and tests on two showed speed variations of the order 9 to 12 per cent., with ¾ load thrown off.

High-Pressure Water-Power Works.

By L. ZODEL, Zürich.

(Abstract of paper read at the Swiss meeting of the INSTITUTION OF MECHANICAL ENGINEERS, 1911.)

THE author reviews the progress made in high-pressure water-power plants of recent years, and brings forward the relative merits of different designs for different purposes.

It is to the pipe-lines that too little attention is usually devoted. Not a few engineers consider that the pipe-line is a secondary part of a hydraulic power plant, so long as the thickness of the pipe allows a good factor of safety against the pressure, and a continuous line has been laid over the ground from the intake to the turbine. Hence it is that pipe-lines are often built by engineers who are experts in the choice of material and in the manufacture of a pipe, but who do not understand the essentially important functions which a complete pipe-line, and especially a high-pressure pipe-line, has to fulfil. The general arrangement, the relative dimensions of different parts of the pipe-line, the methods of anchoring and placing of fixed points, are all such important factors that they can only be properly determined by the turbine builder, because on them depends to a very great extent the proper working of the turbine, and hence the success of the whole plant.

The works of the original Necaxa power station of the Mexican Light and Power Co. have been fully described in various technical journals*; during the last two years, however, very great enlargement of the plant has taken place.

The company have greatly increased the water available by diverting the Texcapa, Tenango, Nexapa and Xaltepuxtla Rivers into the Necaxa reservoir by means of an extensive system of tunnels through the dividing ridges. The catchment area has thus been raised to 154 sq. miles, and can shortly be further increased by another 77 sq. miles by bringing in the large Laxaxalpan stream. The additional storage volume required has been obtained by the construction of a series of earth dams of very great size, forming reservoirs on each of the streams, with a total capacity of 4,220 million cb. ft.

Further schemes provide for an ultimate development of the Los

* See ELECTRICAL REVIEW, September 4th, 1903.

Reyes, Laguna and other reservoirs, which would bring up the total capacity to over 300 million m³., and, at the same time, considerably increase the catchment area.

As a first step towards the enlargement of the power house plant the company decided to increase the capacity of the existing six 8,200-H.P. turbines to 11,000 H.P. each, by fitting new runners and new nozzles. This was successfully carried out, and is an interesting case, since the velocity of the water in each of the six pipe-lines supplying the six turbines was thereby increased to 18 ft. per second. This is an exceptionally high figure, but was not found to be injurious in any way. The capacity of the station thus became 66,000 H.P.

The next step was the erection of two new units of 16,000 H.P. each, built by Escher, Wyss & Co. They are similar in design to

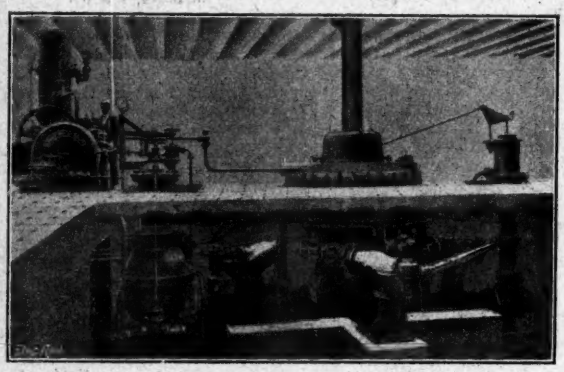


Fig. 1.—Rio de Janeiro: 9,000-H.P. Turbine and Governing Gear.

the old machines, and are supplied with water through a new pipe-line system which has been just recently erected. The capacity of the power station is now 98,000 H.P.

The power works of the Rio de Janeiro Tramway, Light and Power Co., which now supplies the entire city, having a population of 812,000, with light and power, is situated on the Lages River at a distance of 50 miles from the metropolis. The useful watershed comprises an area of 193 sq. miles, and has an average rainfall of 59 in. a year. The Rio das Lages pursues a course through a tortuous valley having a very slight fall for a great distance, and then suddenly descends in a succession of falls and rapids a height of over 984 ft. in a distance of only a few kilometres. This gives a very favourable situation for a hydro-electric station combined with a storage reservoir. The natural flow of the Rio das Lages varies between a minimum of 70·88 cb. ft. per second and a maximum of 21,190 cb. ft. per second, with an average of 460 cb. ft. per second, which is sufficient for 40,000 H.P. continuously with a head of 310 metres.

An artificial storage reservoir, with an area of 8 sq. miles, and mean depth when full of 37·2 ft., has been formed by building an arched concrete dam across the narrow valley above the place where the rapid fall begins.

This lake is the largest artificial reservoir formed by a dam wall at present in existence. It has a total volume of 7,840 million cb. ft., and a total useful volume of 7,206 million cb. ft., obtained with a maximum variation of water level of 19 metres, which represents the difference in elevation of the water intakes. The length of lake is 17 miles, and the total circumference about 137 miles, owing to the extremely tortuous character of the contours. The steep sides of the valley gave an excellent site for the dam, which is thus of very economical proportions for the water storage volume obtained.

The power house is situated at an elevation of 308 ft., giving a gross maximum head of 1,015 ft. The loss of head by friction in the feeders is reckoned at 6·6 per cent., so that the maximum net head at the turbines becomes 952 ft. The difference in the head when the reservoir is full and nearly empty is less than 6 per cent.

The pipe-line has a great similarity to that of Necaxa, and is made in two sections, consisting of two upper low-pressure pipes and of six main high-pressure pipes for the lower portion leading to the power house. Connection is made between these sections by means of a receiver pipe, which serves the purpose of a penstock chamber in power works having an open conduit to convey the water to the pipe-lines.

The power house is constructed entirely of steel and concrete, 72 metres long, 29 metres wide and 24 metres high; 2,500 tons of steel were used.

The six turbines are impulse-wheel machines built by Escher, Wyss & Co., with vertical shaft and four needle-nozzles symmetrically arranged round the cast-steel wheel-disk, which has an effective diameter of 84 in. and is provided with 18 cast-steel buckets. They are designed for a head of 273-290 metres and generate 9,000 H.P. at 300 revs. per min. (fig. 1). An oil-pressure thrust-bearing supports the turbine and generator rotors, which amount to 40 tons dead weight. These bearings are supplied with pressure-oil by three-throw pumps, which also feed the turbine governors. A pressure-relief valve is arranged to limit the rise of pressure in the pipes to 10 per cent. on throwing full load off the turbine. Two exciter units of 400 H.P. each are provided.

The generators supply three-phase current at 6,000 volts and 50 cycles, which is stepped up through transformers to a line voltage of 88,000 for transmission to Rio de Janeiro, the distance being 55 miles.

Up to the present time turbines developing a total of 54,000 H.P. have been installed, and sanction has just been given for a further increase of two units of 19,000 H.P. each.

Power works of very special interest have been recently erected in Norway, and of these one will be mentioned by reason of the difficult work carried out on the pipe line. This is the power plant at Tyssedalen, near Odda, in the Hardanger Fjord on the west coast, where 33,600 H.P. are now utilised and transmitted to carbide, cyanamide, and other factories at Odda, a distance of about 6 km.

The source of power is the Tysse River. The Ringedals Lake provides an ideal natural storage reservoir for the power works at an elevation of 1,426 ft. above, and 2·17 miles distant from the Fjord, at whose edge the power house is situated. This lake has an area of 2·22 sq. miles, and has now been tapped by a regulating tunnel of 64·5 sq. ft. area at a depth of 52 ft. below the normal level; by this means a useful storage capacity of about 2,825 million cb. ft. has been obtained by allowing the level to be drained to this depth during the winter months when the flow of the river is at a minimum. A dam has also been constructed to raise the water-level by 44·5 ft. to a maximum elevation of 1,470 ft., and the useful storage volume is thus 6,000 million cb. ft. The catchment area of 146 sq. miles is sufficient, with the ample rainfall in this mountainous district, to give about 100,000 H.P.

The regulating tunnel from the Ringedals Lake discharges into the little Vetle Lake, immediately below, which forms a second small regulating basin on the river, whose level is adjusted by a needle dam. A tunnel of 11,200 ft. length starts from this lake and passes through the mountain to the penstock chamber, from which the pipe line leads down to the power house. This tunnel is driven through granite for the whole of its length, the work having been carried on simultaneously from 13 adit levels, and completed within two years. The rock was left rough inside the tunnel, the cross section being nowhere less than 102 sq. ft.

The penstock chamber is cut out of the solid rock to a depth of about 49·3 ft., and the tunnel emerges into the bottom of this at an elevation of 1,303 ft. The sill of the overflow of the penstock

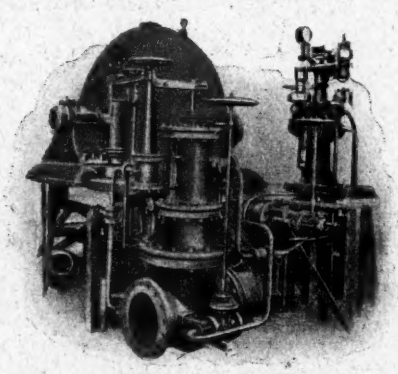


Fig. 2.—Tyssedalen: 4,800-H.P. Turbine and Regulating Gear.

is at elevation 1,353 ft., and the maximum possible water-level due to the head in the tunnel is 1,360 ft.

Two pipe lines of 63 in. diameter connect with this penstock chamber through a short tunnel, and are fitted with sluice valves of 47 in. diameter placed in a valve house at the exit. Flap valves are also arranged over the end of the pipes in the chamber in such a way that the chains which hold them open may be released by electric current from the power house, in case of accident to any part of the plant. The intake would then be closed immediately by shutting the flap. The usual air pipes are fitted to prevent the formation of a vacuum on emptying the pipe line.

The erection of this pipe line was of difficult character, the difficulties being further increased by the necessity of carrying out a large part of the work during the winter months, the erection period being between August and March. All workmen had to be slung with ropes over the face of the rocks, and the pipes reached an inclination of 55° to the horizontal.

A valve is fitted at the bottom of each pipe-line with a safety-plate so arranged as to break in case the pressure in the pipes should rise above 50 per cent. in excess of the normal. In such case the sluice-valve behind the safety-plate could be slowly closed by hand, or the flap-valves over the pipe-line end in the penstock-chamber could be instantly closed and the pipe allowed to empty itself of water, when a new safety-plate would be fitted and the line refilled. This safety-plate has been fitted to many high-pressure pipe-lines, and is a surer means of safeguarding the pipes in case of unforeseen disturbances than the spring safety-valve sometimes employed, although it causes greater inconvenience if it should come into action. The pipe-line water velocity in the lower portion is 15·4 ft. per second.

The two pipe-lines each feed three Escher, Wyss impulse-wheel turbines of 4,800 H.P. maximum output running at 375 R.P.M., with a net head of 1,260 ft., and a seventh machine is held in reserve. These are machines with horizontal shafts and a single needle

nozzle; they are provided with pressure-relief valves for relieving pressure oscillations in the pipe-line (fig. 2). The generators work in parallel directly on to the 12,000-volt transmission line of 6 km. length to Odda.

The whole station was built in the very short period of slightly over two years from the end of 1905 to March, 1908.

An enlargement of this station is now taking place, and a third pipe-line is being erected to supply two turbines of 13,500 H.P. each. This station has now 7 × 4,800 = 33,600 H.P. installed, 2 × 13,500 = 27,000 H.P. being erected, giving a generating total of 60,600 H.P., and exciters 400 H.P., or a grand total of 61,000 H.P.

The plans for the enlargement of the station arrange for seven new sets of 13,500 H.P. each, of which the two now being built are

FIG. 3.—BRUSIO: PIPE LINE AND MAIN ANCHORAGES.

but the first instalment. When these are finally erected, the station will have a capacity of 125,000 H.P., and the generating room will be 150 metres long.

A typical high-pressure power station in Switzerland is that of the Kraftwerk Brusio Co., which utilises the water power of the Poschiavino river in the Poschiavo Valley in the Canton Grisons, on the south side of the Alpine Chain between the Bernina Pass and the Italian frontier near Tirano. About 55,000 H.P. are developed, the greater part of which is transmitted to the industrial districts of Northern Italy over a transmission line 93 miles in length. The total head available is about 3,280 ft., and this is used in two stages. The upper lies between the Lago Bianco, in the Bernina Pass, and the Lago di Poschiavo, giving an effective head of 1,970 ft. for the Robbia station; and the lower is between the Poschiavo Lake and the Italian frontier at Campo Cologno, where the head obtained is about 1,375 ft. The lower station was built first.

The minimum average volume of water available from the Poschiavino river has been found to be 264 cb. ft. per second during a run of 12 hours, and this quantity is equalised by the Lake of Poschiavo, which acts as a natural storage basin of 1·25 sq. miles area. A variation in level of 275 ft. is allowed by the concession, and this is obtained partly by tapping the lake below its normal level, and partly by raising the level with sluices built across the outlet. This gives a regulating volume of about 530 million cb. ft. The lake is about 1,428 ft. above the power house. The intake from the lake is effected by means of a siphon leading into the shaft from which the tunnel starts. The tunnel has a length of 5,250 m., with a gradient of 1 : 500, and leads the water into the penstock chamber, excavated out of the rock, from which five pipe lines descend to the power house.

In straight sections the pipes were bedded on masonry pedestals, while very heavy reinforced concrete anchorages were provided at all angle points, one of these (No. X) near the power house having a total weight of 3,300 tons.

A valve with the usual safety plate has been fitted, so as to break, should the pressure in the pipe line system accidentally rise above 50 per cent. in excess of the normal.

Twelve main turbines are installed in the power house. They are Escher, Wyss impulse tangential machines fitted with horizontal shaft and single needle nozzle, with the exception of two Girard turbines which will shortly be replaced by the tangential type. Ten turbines are of 3,500 H.P. and two of 4,600 H.P., all designed for 400-m. head and 375 R.P.M. Four exciters of 250 H.P. each bring up the total power to 45,000 H.P. Most of this power is transmitted at 7,000 volts across the Italian frontier to the transformer station of the "Compagnia Lombarda," 500 yards distant, and there stepped up with oil-cooled transformers to 50,000 volts for the long-distance transmission system to the sub-station at Lomazzo, which supplies Como and the neighbourhood of Milan. During the daytime the whole station is under full load, but only a small part of it is kept running at night.

Very shortly after the completion of the Brusio Station, the demand for power grew so rapidly that the company was obliged to erect a second station to utilise the upper portion of the head to be obtained in the Poschiavo Valley.

The waters of the Cavagliasca have been impounded for the Robbia power station, and the Lago Bianco, which discharges into it, has been dammed up so as to act as a storage reservoir over winter months when the stream is frozen. Thus it was possible to obtain a head of 1,970 ft. at the power station, and to ensure sufficient water to generate about 7,000 H.P. Three turbines of 3,500 H.P. are therefore intended for the station, of which two are now installed and one is on order.

The turbines of this plant are fitted with the new deflecting nozzle operated by an oil-pressure governor. Similar machines are installed at the Adamello hydro-electric power station.

The River Siagne rises in the Alpes Maritimes to the north of Cannes; the power station utilises a fall of about 1,142 ft. The water is taken from a weir on the upper reaches of the river by a conduit and tunnel to a balancing reservoir above the power house, partly blasted out of the rock and partly formed by a large retaining wall. The Siagne discharges an average volume of about 105 cb. ft. per second at the intake weir, and thus, with the fall of 1,142 ft., provides an absolute output of 14,000 H.P. The Compagnie de l'Energie Electrique du Littorale Méditerranéen has developed this power by means of 5 units of 2,000 KW. maximum each, of which one is held as a reserve.

The Siagne power station provides a specially interesting and most instructive case of high-pressure pipe-lines, and has demonstrated in a most drastic manner what the consequences of incorrect design can be. The original pipe-line had to be abandoned after a few months' running on account of unsatisfactory working of the plant, and an entirely new pipe-line had to be built on totally different principles, in spite of the fact that the chief dimensions of the pipes were perfectly correct and amply sufficient for the conditions of head and discharge, and, moreover, were not altered in the second pipe-line.

The principal faults in the arrangement of this line were as follows:—

1. Too great a length of the upper portion, under low pressure, with pipes of small thickness, whereby a continual working or respirating phenomenon became apparent in this part of the pipe-line.

2. Insufficient fixing or anchoring of the pipes in the lower portion of the line, and a most curious position of the distributing pipe, in which very harmful vibration combined with displacement of the pipes could take place, on sudden variations of water-velocity or shocks in the pipe-line; this might easily lead to a burst, especially in the case of riveted pipes.

3. Unsuitable dimensions of the connecting pipes between the distributor and the turbines, with their length too great and their diameter too small, resulting in considerable accentuation of the pressure variations.

Each pipe-line formed one single rigid piece from top to bottom, and no provision was made to allow for expansion and contraction, such as the insertion of expansion joints. Expansion due to temperature changes in an exposed pipe-line is, however, unavoidable, and if no arrangements are made to allow of longitudinal motion, then additional stresses will be set up in the pipe walls that will be difficult to foresee, and will cause resultant stresses which may under certain conditions have a fatal effect.

Shortly after starting up the works a burst occurred about the middle of one of the pipe-lines, probably owing to some sudden variation in the water velocity. A longitudinal riveted joint was torn open for a length of 2 metres, and the water suddenly streamed with such velocity from the gap that a large part of the upper section of the pipe was completely flattened by the vacuum which was produced, in spite of large air-pipes at the penstock chamber. Exhaustive investigation led to the final decision to replace the entire existing pipe-lines by others over a quite different route.

The new line has been in continuous operation since the spring of 1908. It consists of two parallel pipe-lines of almost the same dimensions as the old, but differs therefrom in that it passes straight down the side of the mountain from the penstock chamber to a point about 30-40 metres above the power house, when it turns round and passes towards the latter through a tunnel.

The upper part of the pipe-line was made as short and as steep as possible and the lower arranged longer in proportion. The whole line is divided into six straight sections; the angle points between them are formed into main anchorages (fixed points) of solid concrete masonry into which the pipe bends are rigidly bedded. An expansion joint is placed below each fixed point.

These pipe lines were riveted together *in situ*, the upper portion, up to 13 mm. thickness, being of riveted pipe, and the remainder of pipes lap-welded by the water-gas process.

The erection of the new pipe line was finished in six months. The result as compared with the old pipe line was as expected. The extraordinary surges and resonance effects of the pressure shocks, especially the visible movement and trembling of the pipes, completely disappeared. No disturbance or irregularity could be observed in the pipe line even with severe and sudden load variations during running.

The five 2,000-KW. (max.) machines installed in the power house run at 375 R.P.M. The turbines are Escher, Wyss & Co.'s impulse wheels of 2,800 H.P. maximum output, having each one regulating needle-nozzle. They are fitted with automatic speed regulators and pressure-relief valves, both operated by the pipe-line water, which is exceptionally clean and could therefore well be used. The rigid coupling which connects turbine and generator is arranged as a fly-wheel to increase the rather small fly-wheel effect of the generators, in view of the exceedingly close governing guarantees required.

The Siagne power station is used as one of the hydro-electric plants which feed the high-tension system supplying power to Nice and Cannes.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

An Electric Water Heater.

A novel form of water heater has been introduced by Electric Water Heaters, Ltd., of 30, Gordon Street, Glasgow. It consists of one or more porcelain tubes packed with carbon granules, so arranged that water flows through them freely; the granules are of uniform size, carefully packed, and are prevented from escaping through the ends of the tubes by carbon blocks. On passing a current through the granular resistance, water which is led through the tube is efficiently heated, and, at the same time, sterilised; the latter feature has been verified by Prof. David Ellis, who carried out experiments with contaminated water containing one and a-half million bacteria per cm^3. This was passed through the heater, and within a few seconds the out-flowing water, heated

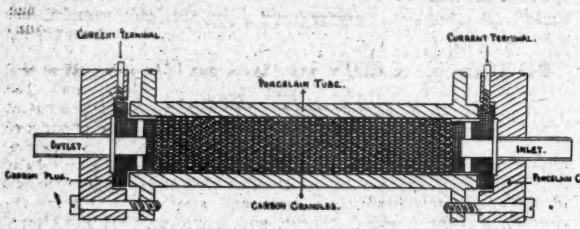


Fig. 1.—Electric Water Heater (Section).

to 125° F., was collected and found to be free from pathogenic organisms—two out of three samples being, in fact, "absolutely sterile," and the third containing only 30 bacteria per $cm.^3$, of a harmless character. Among the other advantages claimed for the heater are its quickness of operation, ease of control and of fixing to any cold water supply, and freedom from waste. The heaters at present made take 3,000 and 6,000 watts, and have respectively an output of 25 and 50 gallons of water per hour at 110° F. The water does not come into contact with charged metal, and therefore there is no danger of poisoning by electrolysis.

"Handgrip" Heavy-power Fuses.

The latest Home Office Regulations for factories and workshops provide, among other things, that fuses must be so constructed as to prevent danger from arcing, overheating, or from the scattering of hot metal when the fuses come into operation. Further, they must be so arranged that the fusible metal may readily be renewed without danger. To meet these conditions, the British Central Electrical Co., of 84, Hatton Garden, E.C., are supplying a range of fuses and fuseboards for use on motor and other circuits at pressures up to 600 volts. The fuse carriers are known as the "Handgrip," and are of tubular form, with clear central hole lined with asbestos to take the fuse wire. They are of porcelain, arranged so that the contacts are entirely shielded, a

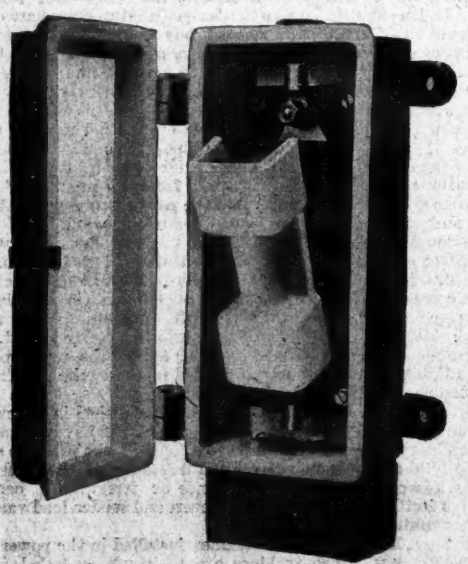


Fig. 2.—"Handgrip" Service Fuse.

space being left between the tubular part of the carrier and the porcelain back, of sufficient size to accommodate the fingers. It is thus impossible inadvertently to touch live metal with the hand when withdrawing the carrier, or replacing it after it has been removed from the board. The company lists tubular fuses made up in single, double or triple-pole form on enamelled slate or mica-insulated iron boards, with front or back connections. They are also made up in cast-iron boxes as main service fuses, as shown in the accompanying illustration. These cases are watertight, and can be supplied with or without sealing chambers for the supply cables. These "Handgrip" fuses are also made up in iron cases as distribution boards for heavy-power circuits, and are supplied in five sizes, to deal with currents from 50 to 500 amperes.

LEGAL.

Milne *v.* Municipal Council of Sydney.

This case has been occupying the attention of the Australian Courts, Supreme Court, in Banco, before the Chief Justice, Mr. Justice Pring and Mr. Justice Sly. The report is from a Sydney newspaper:—The plaintiffs, Alexander Martin Milne, William Milne, Andrew Milne and Martin Luther Milne, had commenced an action against the Municipal Council of Sydney, and their declaration set out that in consideration that the plaintiffs would execute and complete the mechanical repairs to the Council's plant at the electrical power house, Pyrmont Street, for the term of 12 months, at certain prices, and in accordance with certain conditions agreed upon between them, the Council promised plaintiffs, amongst other things, to allow them to do the work referred to, and for the period stated; but, although certain repairs to the mechanical plant were required during the 12 months, the defendant did not give the work to plaintiffs, but to other persons, and refused to be bound by the promise, whereby the plaintiffs lost the benefit of the promise and the profits they would have derived from the performance thereof, and the expense incurred by them in preparing to carry out the agreement on their part. Damages were laid at £2,000.

In reply to this declaration the defendants set out as their plea in defence the articles of agreement of April 20th, 1910, between plaintiffs and the Council, instructions to firms tendering general conditions, the specification, plaintiffs' tender, and other documents. To this plea the plaintiffs demurred, on the ground, mainly, that under the agreement set out in the plea and during its currency, the plaintiffs were entitled to carry out all the work of repairs referred to in it, and that the plea admitted the breaches complained of, and that the agreement was no answer to their claim.

Argument had not concluded.

Breach of Electrical Regulations.

At the Jarrow-on-Tyne Police Court on September 7th, the Palmer Shipbuilding and Iron Co. were proceeded against by Mr. W. B. Lauder, Chief Inspector of Factories, on behalf of the Home Office, for an alleged offence under the Factory and Workshops Act, on July 7th. Mr. Gibson, of Messrs. Clayton & Gibson, Newcastle, appeared for the defendant company, and pleaded guilty.

Mr. Lauder said that the company was charged with a breach of the electric regulations made in pursuance of the Factory and Workshops Act for the protection of life and limb in factories. Regulation 21 provided that, where necessary to prevent danger, adequate precaution should be taken either by earthing or other suitable method to prevent any metal from becoming charged. In that case they were concerned with the death of a man named James Byers, who was employed as a driller on July 7th last. He was engaged at a radial drilling machine, drilling a steel plate 24 ft. long × 12 ft. wide. The drill was driven by an electric motor. Byers had been employed from 5 p.m., and about 9 p.m. he was observed lying over the handle of the machine with his feet stretched over the plate. A workman named Atkinson attempted to release Byers, and received such a shock that he was incapacitated for some time. Another man named Wilson also attempted to free him, and received a slight shock. The current was then switched off, but all efforts to revive Byers proved futile. Mr. Lauder said that the charge against the company was that they had not taken adequate means to prevent danger, by earthing or other method. He added that it was possible at any time for a puncture to occur in the cable, but if the motor were earthed, any leakage would not affect the machine. As it was, the whole of the machine and the steel plate became charged, so that the man received a full voltage of 440 volts alternating three-phase, which was sufficient to kill anyone. In regard to this machine, no steps had been taken to comply with the regulation. The machine had been erected two months before the accident, in the absence of the foreman electrician, who, on his return, did not examine it to see if it was erected properly. As to how the leakage occurred between the cable and the motor frame was not material to the case, but they could take it that the leakage had occurred through a very slight flaw in the cable. As the company admitted the offence he did not propose to ask for the extreme penalty (£100), although it was a most serious thing.

Alfred Baker, of Jarrow, the foreman electrician to the Palmer Co., stated that after the accident he examined the drilling machine. There was no earthing; if there had been the whole of the machine would not have become charged.

Mr. Lauder: There were three other machines of a similar type in the yard; none of them earthed?—Yes.

They had been erected in your absence?—Yes.

Witness, in reply to questions, stated that they had been erected by his assistant.

The Chairman (Alderman Johnson): Can you account for having three machines not earthed?—They were not earthed at the time.

The Chairman: Do you think it was an oversight or was due to a want of judgment?—I would say it was pure neglect.

The Magistrate's Clerk: Was it not your duty to examine the machine on your return after your temporary absence?—I should have examined it.

The Chairman: You thought you had a qualified man in charge, and that he would do his duty?—Yes.

Mr. Lauder: Were there other machines working without being earthed?—Yes.

Mr. Gibson, for the defence, said he had no option but to admit the offence. The company greatly regretted the serious consequences that had resulted. The machine was erected in the absence of Mr. Baker, who, on returning, saw it working, and he considered earthing was such an elementary principle in electrical work that he did not go to see if the machine was earthed. The only possible explanation of the accident was that there was a very small puncture in the cable. Since the accident his clients had appointed a qualified electrician to take charge of the whole electrical machinery of the works. He thought H.M. inspector was satisfied with what the company were going to do, and they were willing to adopt any suggestion that Mr. Lauder might make. It was certainly not the wish of his clients that any of their workmen should work in danger.

A fine of £10 and costs was imposed.

Balmain Electric Light and Power Supply, Ltd., *v.* Cormack.

An interesting case was recently before the Australian Courts. Plaintiff company sought an injunction to restrain defendant, till the hearing of the suit, from installing or using any form of motive power for his works other than the motive power supplied by the plaintiff company. According to plaintiffs, defendant agreed on September 29th last to obtain electric power from them for carrying on his extensive cooperage works at Long Nose Point, Balmain, and gave an undertaking in writing that he would not install or use any other power for a period of two years. Plaintiff company then went to great expense in erecting a sub-station, and extending the mains to defendant's works. Defendant, however, had recently installed a steam plant, and was using that as the motive power for his works. Plaintiffs had asked defendant to take the power from them, but he had refused, and neglected to do so, whereby they had suffered great loss and damage.

Defendant, in an affidavit, said he had been carrying on business at Balmain as a master cooper and sawmiller up to December 20th last, on which day he sold the business and the assets and goodwill thereof to A. W. Cormack, Ltd., a company duly registered and incorporated under the Companies' Act. Since that date he had not carried on, nor was he carrying on, the said or any business at Balmain or elsewhere. He denied that he had recently installed a steam plant for the purpose of supplying motive power for the works mentioned, or for any purpose, and also denied that he intended to use steam for such purpose. The said A. W. Cormack, Ltd., had installed a steam plant, and he, as a servant of the company, and not otherwise, used the plant. A denial was also given to other statements of plaintiff company. The matter was allowed to stand over for a fortnight, to enable A. W. Cormack, Ltd., to be joined as a defendant.

BRADFORD RAILLESS TRACTION SYSTEM.

Mr. C. J. Spencer, Corporation tramways manager at Bradford, submitted the following report on the proposed extension of railless trolley system, to the Tramways Committee:—

"I have pleasure in reporting on this matter in accordance with the following minute:—'*Railless Trolley System—Proposed New Routes.*—It was decided to recommend the Council to apply to the Board of Trade at the earliest practicable date for a provisional order authorising the Corporation to use trolley vehicles on the following routes within the city, namely, from Laisterdyke to Junction Hotel, Bolton, *via* Killinghall Road and Idle Road; and from Dudley Hill to Bankfoot, *via* Rooley Lane. The general manager was requested to consider what districts of the city might be profitably served by an installation of the railless trolley system, and to report generally thereon, dealing particularly with the following routes, namely, Odsal to Oakenshaw, and Forster Square to Frizinghall, *via* Canal Road.'

"Sec. 17 of the Bradford Corporation Act, 1910, reads (*inter alia*) as under:—'If at any time hereafter the Corporation desire to use trolley vehicles upon any road as defined by the Tramways Act, 1870 (other than the streets or roads in this part of the Act specified), they may make application to the Board of Trade, and the Board of Trade shall be, and are hereby empowered, to make a provisional order authorising the use of trolley vehicles upon any route or routes within the city to which such application relates.'

"Certain procedure, which is stated at length in the Act, has, of course, to be observed.

"From an engineering and operating point of view the railless trolley system has been an unqualified success

"No serious difficulties of any sort have cropped up during the few weeks of running on the Laisterdyke-Dudley Hill experimental section, such as might have reasonably been expected in connection with a new installation of this description.

"Several minor details require attention by the contractors who are fully responsible for the same, and these will in due course be put right by the contractors under the terms of their contract.

"From the traffic revenue point of view, I am sorry to say, the returns are not quite up to the figure I anticipated. We had, of course, no experience of the traffic value of a cross-town route in Bradford, and I am surprised to find that instead of a 10 to 20 minutes' service being required for the district, a 15 to 30 minutes' service seems to be ample to meet normal requirements.

"The route is, of course, very short, and hardly serves a sufficiently wide area to fairly test the traffic possibilities of the district. In all probability the traffic revenue will improve very considerably when the route is extended, as I have already suggested, with suitable overlapping stages.

"The proposed route from Odsal to Oakenshaw, *via* Low Moor, would undoubtedly be a suitable route if arrangements could be made with certain authorities outside Bradford to continue to Cleckheaton, &c., but without that it seems to be somewhat doubtful, having regard to the fact that a portion of the route would be over the bridge and approaches at Low Moor now maintainable by the Lancashire and Yorkshire Railway Co.

"There is some reason to believe that in the near future it may be possible to have through communication with the Cleckheaton district in the way suggested. It is, therefore, a question for the Committee to decide whether this route should be applied for until some understanding has been arrived at with the authorities concerned.

"I beg to recommend the following extensions of this system, all of which are inside the city boundary:—

"(*a*) From the existing terminus of the railless route at Dudley Hill, along Rooley Lane to Bankfoot, 1 mile, 1,322 yd., and from the existing terminus of the railless route at Laisterdyke along Killinghall Road and Dudley Hill Road to the Bolton Junction, a distance of 1 mile, 1,352 yd.

"(*b*) From the junction of All Saint's Road and Laisteridge Lane along All Saint's Road, Grange Road, Ingleby Road, Whetley Lane, Marlborough Road and Queen's Road to Peel Park, a distance of 3 miles, 494 yd.

"(*c*) From Forster Square, along Canal Road to city boundary at Frizinghall, a distance of 2 miles, 365 yd.

"The total route mileage recommended is 9 miles, 13 yd., and would cost approximately £13,500 for street equipment.

"Assuming an average service of 15 minutes, 12 cars would be required including spares, at an estimated cost of £9,000.

"Depôt accommodation would be required at an estimated cost of £4,000. The total amount of capital required, therefore, would be £26,500, and the annual charges approximately £2,247.

"The amount of revenue from traffic from the routes mentioned is very problematical. The routes are well known to the Committee, and I am of opinion that the cross-town traffic will be ample to pay working and capital expenses, with some profit, but it is impossible to deduce traffic possibilities to even approximate figures in the usual way of estimating population, &c.

"Subject to the opinion of the city engineer (Mr. Dawson), the roads along which it is proposed to run appear to me to be very suitable for railless trolley traction, and I see no special difficulties of an engineering character in the project."

The foregoing report was considered by the Committee on Monday last, and was adopted. The recommendations will be placed before the City Council in due course.

BUSINESS NOTES.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., Rugby.—We have received from this company a batch of new literature just issued regarding a number of its manufactures. Price list No. 304 is devoted to "Mazda" holophane reflectors of the domestic type, which have been specially designed for use in houses where artistic appearance is essential, combined with efficiency. No. 305 is a 40-page list with many good half-tones and line diagrams, and a great deal of descriptive material concerning the B.T.-H. ironclad oil-break switchgear, made for operating under severe requirements of service on systems of 3,300 volts or less. Price list No. 306 (four pages), non-luminous radiators, shows a new type of radiator suitable for public building and hall heating, office heating, ships' state rooms, tramcars, shop-windows, &c. In No. 307 the "Magnetite" arc lamp for continuous-current circuits is particularised. We understand that the largest single order for arc lamps has just been placed, being for 6,000 of the latest type "Magnetite" lamp. Finally, in list No. 308, the B.T.-H. drawn-wire filament "Mazda" lamp is very fully-covered, tables of sizes, consumptions, candle-powers and prices being given, together with typical views of interiors where these lamps are rendering effective service. All of this literature is issued in the familiar standard B.T.-H. style and size.

Messrs. Tetley & Co., Falcon Electrical Works, Salford.—Price leaflets relating to voltmeters and ammeters, liquid starters and controllers.

The Brush Electrical Engineering Co., Ltd., 1, Kingsway London, W.C.—Coloured showcard to impress upon all and sundry that the "Metallum" lamps turn night into day. The picture, which is in colour, represents an aviator, holding a mammoth Metallum lamp suspended by flex, lighting up the waste places of the earth.

The Benjamin Electric, Ltd., 117, Victoria Street, London, S.W.—Section lists Nos. 41 and 42, the former illustrating, describing and pricing, reflectors for shop window showcase lighting, &c., the latter dealing similarly with patent lampholders and adaptors.

Messrs. Litholite, Ltd., 55, Hackney Grove, London, N.E.—Some new sheets have been issued for inclusion in the firm's catalogue. No. 16 is a reprint with additional patterns of insulating bushes, nipples, &c., which is to take the place of the existing No. 16; Nos. 18 to 23 show sketches and prices of brush-gear insulators, and H.R. grade insulators.

Electrical Power Storage Co., Ltd., 4, Great Winchester Street, London, E.C.—Folding leaflet containing illustrated information regarding the E.P.S. miners' electric safety lamps, fitted with "Osmi" filaments, and giving prices of five different models. Copies of the bulletin can be obtained by the trade on application.

The Forest City Electric Co., Collier Street, Greengate, Salford.—Eight-page pamphlet entitled, "The Bonding of Girder Tram Rails," in which the efficiency of short bonds is pointed out, notes being given on the fixing of bonds, describing the use of the double-screw rail bond compressor, and giving illustrations, brief notes and prices, of the "Protected" bonds, the "Forest City" flexible cable bonds, and solid wire rail bonds.

British Central Electrical Co., 84, Hatton Garden, London, E.C.—16-page catalogue of various electrical manufactures, including "Handshield" fuseboards, adaptors, plugs, &c., also cut-outs, ironclad switches, watertight fittings, shop lighting fittings, main switches, flexible cords, bell and telephone and other wires, "Handgrip" ironclad main service fuses, and other lines.

Messrs. Johnson & Phillips, Ltd., Victoria Works, Charlton.—New 72-page price-list of switchgear. It is full of detailed and well-illustrated descriptions of such manufactures as oil switches, isolating switches, current and potential transformers, choking coils, measuring instruments, accumulator switchboards, battery charging and other types of switches, ironclad switches and fuses, distribution boards, power distribution boards, circuit-breakers, rotor starters, auto-starters, &c. Copies of the list will be sent to any firm in the trade making application.

Messrs. W. and R. Jacobs, 39c, King William Street, London, E.C.—24-page catalogue of pocket flash lamps, torches and electric novelties for the 1911-12 season. The list is fully illustrated and priced.

Messrs. Matthews & Yates, Ltd., Cyclone Works, Swinton, near Manchester.—New 20-page booklet, containing a description of the Cyclone oxy-acetylene process of autogenous welding. The parts are illustrated, prices of complete plants are stated, and other contents included comprise useful data tables, a list of uses to which the process may be put, and instructions for working the acetylene generator and for welding with the Cyclone blowpipe.

Mr. G. Braulik, 8, Lambeth Hill, Queen Victoria Street, London, E.C.—Pamphlet No. 20 (20 pages) contains illustrations and notes of prices of a variety of designs and styles of glassware and enamelled iron shades for electrical fixtures.

The Franco-British Electrical Co., Ltd., 50, Oxford Street, W.—New catalogue of 16 pages containing descriptive details of their "Franco" signs, motor flashers, time switches, parallel and flexible strip, &c. A number of the signs are illustrated and prices are quoted. A lengthy list appears of places where "Franco" signs may be seen in London.

The Electrical Co., Ltd. (Meter Department), 122 and 124, Charing Cross Road, London, W.C.—This is a fine art paper publication of 90 pages in which is contained a general review of the company's various types of electric meters for all conditions of service. From the illustrator's point of view the work is very impressive, for at periodical stages there are included fine representations in colour admirably showing the mechanism of the different types with covers removed; also half-tone views of departments of the works showing the various processes in meter manufacture in progress, diagrams of constructional details, and numerous curves. As to the general arrangement of the contents, these are set out in seven sections as follows:—Continuous-current ampere-hour meters; continuous-current watt-hour meters; single-phase A.C. meters; polyphase A.C. meters; various types of meters for special systems; various types for miscellaneous purposes; testing equipment, calibration, and connections of meters. Notes on testing and calibration, also diagrams of connections appear at the end.

Bankruptcy Proceedings.—Alfred Sitch, metal worker and electrical engineer, described as of 77, Brecknock Road, N. A sitting of the London Bankruptcy Court was held on Tuesday, before Mr. Registrar Giffard, for public examination. The statement of affairs showed total liabilities £1,349 (unsecured £239), and assets "£2,450 ordinary shares in W. Sitch & Co., Ltd.," returned as of uncertain value. Questioned by Mr. Walter Boyle, Assistant-Receiver, the debtor stated that on the death of his father, who carried on business as a metal worker and electrical engineer, he continued the business on behalf of his mother, who died in November, 1908. The business was left equally to witness and his sister; they carried it on together in partnership until January, 1909, when she retired, and in the following March, witness sold it to W. Sitch & Co., Ltd., which was formed with a capital of £1,000 in debentures and £4,000 in ordinary shares. Witness received as purchase money £250 in debentures and £2,500 in shares; he transferred the debentures to certain creditors in satisfaction of their claims, and he acted as managing director of the company at a salary of £250 a year. Owing to the loss of several large customers, and to £950 by bad debts, the company was not successful, and on January 4th last a debenture-holder appointed a Receiver, by whom witness was now employed to manage the business at a weekly salary. In March last judgment was obtained against him for £55, balance of a loan of £100 borrowed on behalf of the company, and a petition was subsequently filed, upon which the receiving order was made. Witness attributed his failure and insolvency to the failure of the company, and the liabilities incurred by him on its behalf. Proper books of accounts were kept prior to the sale of the business to the company. The examination was concluded.

G. V. B. Barker, electrical engineer, Leeds and Harrogate.—September 23rd is the last day for receipt of proof for dividend, by the trustee, Mr. D. S. Mackay, The Red House, Duncombe Place, York.

Book Notices.—*La Nouvelle Industrie des Lampes Électriques à Filaments Métalliques.* By C. Mourlon. Brussels: J. Lebègue & Cie. 1911.—In this volume the author reviews the history and development of the metallic-filament lamp, with special reference to the "Z" lamps, originally made by a company in Belgium, and now manufactured in eight countries to the tune of about 12 millions a year. The process of manufacture is briefly described, and numerous tests on various types of incandescent lamps are quoted; particulars and illustrations of the various works where the "Z" lamp is made are also given.

The Bioscope Electrician's Handbook. By J. W. Barber. London: Ganes, Ltd. Price 1s.—This is a "waistcoat pocket-book," giving in the briefest form such information as the bioscope operator is likely to need; diagrams of connections for various arrangements, with and without motor-generators, &c., a dictionary of electrical terms (which appears to be very reliable), sections on electrical units, the projector arc, automatic arc lamps and resistances, and various wiring tables. It is a useful little book, and should fill a want very satisfactorily.

Small Switches, &c., and their Circuits.—A book bearing this title, by Mr. Perren Maycock, M.I.E.E., will be published in a few weeks' time by Messrs. S. Rentell & Co. This new book is not intended to supersede Mr. Maycock's two recent publications, "Electric Wiring, Fittings, Switches and Lamps," and "Electric Wiring Diagrams," but will form a kind of supplement thereto.

"La Propagazione e lo Smorzamento delle Sovratensioni." By Ing. G. Campos. Extract from the Atti della Associazione Elettrotecnica Italiana. Milan: from the author.

"The Physical Review." Vol. XXXIII, No. 2. August, 1911. Lancaster, Pa.: The *Review* offices.

"Atti della Associazione Elettrotecnica Italiana." Vol. XV, No. 7. Milan: Stucchi, Ceretti & Co.

"Manual of Wireless Telegraphy for the Use of Naval Electricians." By Com. S. S. Robison, U.S. Navy. 1911. London: S. Rentell & Co. Price 7s. 6d. net.

"*Journal* of the Institution of Electrical Engineers." London: E. & F. N. Spon, Ltd. Price 5s.—The issue for August, 1911, contains the following papers:—"The Laying of Transmission Cables," by C. Vernier; "Battery Economics," by A. M. Taylor; "Printing Telegraphy," by Donald Murray; "Chemical Action in the Windings of High-Voltage Machines," by A. P. M. Fleming and R. Johnson; "The Non-Salient Pole Turbo-Alternator," by S. P. Smith.

"Electrical Ignition for Internal Combustion Engines." By M. A. Codd. 1911. London: E. & F. N. Spon, Ltd. Price 3s. net.

"*Proceedings* of the Sydney University Engineering Society." Vol. XV. 1910-1911. Sydney: The Society.

Enamelled Plates.—The Flitton Engineering Co., 4, New Cross Road, London, S.E., who specialise in the manufacture of enamelled-iron signs, have sent us a sample of one of these as supplied for attachment to buildings, indicating that electricity is used on these premises for such and such purposes, and it is furnished by —— Supply Co.

Model Exhibition.—The third exhibition of small-power engineering appliances, models, and scientific apparatus, organised by the proprietors of the *Model Engineer*, will be held at the Royal Horticultural Hall, Vincent Square, Westminster, S.W., from October 13th to 21st next. As usual, it will contain a collection of high-class working and stationary engineering models of all kinds, as well as a display of small-power steam, gas and oil engines, lathes and light-machine tools, electrical appliances, and scientific novelties. A feature of the show will be a completely equipped model engineering workshop, in which demonstrations of metal-working processes and small engine building will be given daily. Working model railways and numerous other interesting trade and private exhibits will be provided. Full particulars may be obtained from the organisers, Messrs. Percival Marshall & Co., 26-29, Poppin's Court, Fleet Street, London, E.C.

Trade Announcements.—In a paragraph under this heading last week the name Farraway was given instead of Harraway, the latter being the correct title of the firm mentioned.

Messrs. Feld Bros. & Co., Ltd., have removed to more commodious offices and stores on the ground floor of 25, Budge Row, Cannon Street, E.C. Their telephone number is altered to "1501 London Wall" (two lines).

Messrs. W. T. Glover & Co., Ltd., have removed their Glasgow offices and stores to 158, Hope Street, Glasgow, and the telephone number has been changed to "3856 Douglas, Glasgow," their telegraphic address remaining as before, viz., "Conductors," Glasgow.

Mr. Horace Sloman, late of the Starlight Electric Co., has commenced business as an electrical engineer at 3, Horace Road, Southend-on-Sea.

Mr. Wm. Scholes, of 23, Church Road, Eccles, has taken over the electrical department of Messrs. J. O. Hart & Co., Ltd., lately carried on at the above address, and at Bank Street, Bolton.

Mr. J. G. Wilson has severed his connection with Messrs. Lind and Co., Ltd., Liverpool, and is starting on his own account at 12, Sandon Street, Liverpool.

The Electrical Engineering and Agency Co., Ltd., has been formed with Mr. C. Leven as managing director, and in the premises, 109-111, New Oxford Street, W.C., formerly occupied by the Lahmeyer Electrical Co., Ltd. The directors are the same as formed the board of the latter company. The firm will shortly be issuing a new catalogue of electrical specialities in power and lighting machinery and apparatus.

Installation Contracts.—Among installation contracts recently booked by Mr. H. Moss is one for a generator and motor, with switchboard and wiring for 150 lights, for Messrs. R. Beanland & Co., Ltd., of Huddersfield, and others for complete lighting installations for the new offices of Messrs. Ira Ickringill and Co., Ltd., and the Saxone Shoe Co., Ltd., both of Bradford.

A Question of Trade Practice.—Referring to "Importer's" letter on this subject in our issue of September 1st, The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, write that it has been their invariable custom to supply pure rubber type of the full weight ordered *exclusive* of paper, and this point is specially emphasised on p. 14 of their Price List No. 27.

Liquidations.—La Plata and Ensenada Tramways Co., Ltd.—A meeting is to be held on October 9th at 28, Basinghall Street, E.C., to hear an account of the winding up from the liquidator, Mr. J. H. Swinburn.

Acoustic Patents, Ltd.—First meeting of creditors and contributories are called for September 26th at Carey Street, W.C.

Publicity Literature.—Referring to our correspondents' comments on this subject in the last two issues of the Electrical Review, Mr. R. Borlase Matthews points out that excellent literature prepared by experts is now obtainable, so that there is no need any longer for the putting forth of amateur efforts in a business which lends itself so well to co-operation, for each electricity supply undertaking has practically a monopoly in its own territory, since it does not compete with other electricity supply undertakings.

Mention has been made of the fact that there is need for an elementary book that would deal authoritatively with the cost of using electric light, the saving to be effected, the advantages it possesses over other methods of illumination, &c. In this connection Mr. Matthews refers to his book entitled "Electricity for Everybody" (published by the Electrical Press, Ltd.), which was expressly written to cover such points as these, and not only to give general information on a logical basis to the general public, but also to serve as a handbook for central station engineers and their assistants, in their efforts to popularise electricity. The original MS of this book has been edited by the Association of the American Electricity Supply Companies, and adopted as their official handbook; eight editions have already been published—a fact which illustrates the demand for definite information regarding the costs and advantages of electric service.

LIGHTING and POWER NOTES.

Atherton (Lancs.).—Owing to the great increase in the number of consumers in the centre of the town, larger transformers have to be installed, and tenders are to be invited.

Australia.—Sydney.—At a recent meeting of the Electric Light Committee of the City Council, the city electrical engineer stated that the Council had undertaken to supply electricity in 13 municipalities as follows: Woollahra, Randwick, Annandale, North Botany, Botany, Glebe, Erskineville, Darlington, St. Peters, Alexandria, Waterloo, Drummoyne, and Redfern. Several other municipalities, Mr. Forbes Mackay added, would probably decide within the next few weeks to take their supply from the City Council. The majority of the Councils named had only come to a final decision within the last few weeks. The City Council had been compelled by competition to do its utmost to induce these municipalities to take their supply of electricity from the Council, and to come to a decision quickly. Up till recently, the officer considered that with the generating plant recently installed, the Council would have been able to supply all possible demands up to the winter of 1913; but the sudden advent of customers had completely altered the situation. It was now necessary to provide more generating plant to meet the emergency, and he therefore recommended that a duplicate set of the two 4,000-kw. sets recently installed be ordered from Messrs. Dick, Kerr and Co., on certain conditions, at a cost of £17,285. The Committee had some doubt about giving an order in the way suggested instead of calling for tenders for the plant. The matter was accordingly postponed for a few days.

The Redfern Council has accepted the offer of the Sydney City Council to pay it £20,000 for its electric light installation, poles and wiring only. The Council expect to realise £6,000 by the disposal of the machinery, plant and land. The Sydney Council will erect a sub-station at Redfern.

The *Sydney Telegraph* states that the electric light was turned on at Moree late in July. The delay is explained by many unforeseen mishaps, including the loss of machinery by shipwreck, and the refusal of the Minister to grant the company a lease till May 16th.

Bendigo.—"Renewed attention is being given in the Bendigo district of Victoria to a plan mooted some years ago for the supply of electricity for haulage and other purposes at the various mines. The cost of firewood is becoming an increasing burden, due partly to the increasing depths at which the mines are being worked, and the great extension of the underground workings generally, and partly to the fact that the timber areas near the mines have been cut out, necessitating the carting of firewood from greater distances. Many years ago Mr. G. Smith Morison, M.E., M.A.I.E.E., suggested electrification in place of steam power, and that one central station should be erected from which the necessary power could be supplied to all the mines within a given radius. Mr. Morison, who is the Melbourne manager for Siemens Bros. Dynamo Works, Ltd. (of Berlin, Sydney and Melbourne), Mr. Walter Tuerk (a central station engineer), and Mr. Hoffman (a geological expert of the Prussian Government), who is at present "loaned" to Messrs. Siemens Bros., has visited Bendigo and revived the proposal. In company with Messrs. H. E. Mills and W. Honeybone (town clerk), he visited the Hustler's Royal Reserve, Garden Gully, Koch's Pioneer and New Moon Mines, and the impression the experts gained was that the Bendigo field was most suitable for the application of electric power. The system which it is proposed to install is the Siemens-Ilgner, and it is believed that by it all necessary power can be supplied at half the cost at present incurred by each company. Fuel will be required only at the central station, where current for distribution amongst the mines which enter into the agreement will be generated. Nothing definite has yet been decided, but some such modernising step is inevitable if the mines are to continue in operation. The costliness of fuel is not the only consideration which will compel the companies to abandon the antiquated system which has been absurdly adhered to through all these years. There is a persistent demand for higher wages, and whatever increase may eventually be decided upon, it will be such as will make economy in another direction absolutely necessary."—*Australian Mining Standard.*

The same contemporary says that Corowa, which is just "over the road," as it were from Victoria in the New South Wales territory, has decided to install electric light and an electric pumping plant. The Council has agreed to a scheme which was prepared by Mr. G. A. Julius, consulting engineer. It is proposed to install a 50-kw. set, probably in two units, driven by either a suction gas engine or a Diesel oil engine, and to install an electrically driven model three-throw pump. The cost of the scheme will be about £6,000. It is believed that the proposed system of pumping will effect a big saving over the present plant, in fact, sufficient to provide the electric lights for the town, and interest on the capital invested and depreciation.

Ayr.—Mr. Roland Marshall, Corporation electrical engineer, reported to the Council on Monday, that the total income in his department for the year was £14,851. Private lighting brought in £8,282, power £1,122, public lighting £3,020, and tramways £2,123. There was a surplus at the close of the year of £2,256, of which £1,146 had been allocated to the credit of the rates, and £1,110 to reserve fund, which now amounted to £2,931. It was proposed that the charge for current to private consumers be reduced from 4d. to 3½d. per unit, and this was agreed to. The annual report on the tramways showed a record revenue in that department. The net credit balance on the year's working was £2,884. The total revenue was £15,492, as compared with £15,000 last year. The working costs were 7·27d. per car-mile.

Bacup-Rochdale.—At the Bacup T.C. on 6th inst. it was resolved that application be made to the L.G.B. for sanction to the borrowing of £1,250 for electricity purposes, to be repaid in 25 years. A letter was read from the Rochdale Corporation tramways engineer, certifying that the sum of £10,569 was due to the Rochdale Corporation for payments made to date on account of the Bacup Light Railway (electric tramway between Bacup and Shawforth). Rochdale Corporation offered to lend the amount required for capital cost, and it was resolved that it be left with the town clerk and borough accountant to arrange the loan. It was resolved that a list of ordinary and special services for electric lighting be approved, and that the work of laying them be given to Messrs. W. T. Glover & Co., Ltd., to execute under the terms of their contract.

Bampton.—The Urban Council has sealed an agreement with Mr. Purves, Exeter, for the provision of electric light to the Council for £49 a year for seven years. He will start the installation of the scheme in three months and complete it in nine.

Bath.—The accounts of the electricity department for the year ending March 31st have just been published. The revenue account shows total expenditure of £10,718, and total receipts of £20,435. The income is made up of £18,033 from sale of current, including £4,622 from public lighting, and £1,493 from the rental of meters, and other apparatus on consumers' premises. The net revenue account shows that

last year's adverse balance of £580 had been converted into a balance carried forward of £1,196, although the actual deficit last year had been met by a contribution from the rates. The amount tranferred to the sinking fund from the net revenue account was £5,621.

Bexhill.—In his annual report on the municipal undertaking, the engineer (Mr. W. T. Le Feuvre) says that the most satisfactory feature is the reduced coal bill for the year. Although 50,000 more units of electricity were sold, the amount paid for coal was £51 less than in the previous year. The coal bill was £537 less than it was two years ago, which is regarded as conclusive proof of the efficiency of the new chain grate stokers, condenser, cooling tower, and induced draught plant. The net income on the year's working was £561. Altogether a sum of £71,000 has been invested in the business. Last year the revenue from all sources amounted to £10,908, the gross profits being £5,074, representing a dividend of 7 per cent. on the capital borrowed. Capital repaid amounts to £17,680, of which £2,611 was repaid last year.

Blackpool (St. Annes).—The lighting of the northerly side of the road between Lytham Road and Middle Lane has been discussed at a joint meeting of representatives of the Blackpool Corporation and St. Annes U.D.C. It was recommended that an agreement be entered into for 15 years, electric light being adopted, the mains to be laid as far as possible in the highway. One-half of £2 17s. 6d. per lamp per annum is to be paid by St. Annes to Blackpool, the charge being subject to revision at the end of 10 years.

Carnarvon.—The T.C. is considering the advisability of improving the lighting of the town by electricity. The National Electric Construction Co. has presented a scheme by which lamps equal to 9,000 C.P. could be installed, double the present light, with no additional burden on the rates. The matter is to be gone into fully at a special meeting.

Cape Town.—The total number of units supplied from the Corporation electricity works during the five months ended May 31st, 1911, was 1,455,249 units, compared with 1,270,223 units during the same period of 1910, or a net increase of 17·55 per cent., the revenue accruing being £23,983, compared with £21,856, or a net increase of 12·07 per cent.

A fire recently occurred in the electric light storeroom in the railway terminus. The store, which was of brick, lined with matchboarding, was considerably damaged inside. Two of the firemen received shocks through coming in contact with "live" wires.

Continental Notes.—FRANCE.—La Société d'Eclairage Electrique de la Sologne is the name of a new company which has just been formed in Toulouse with a capital of £6,000 to establish a small central electric lighting station at Motte-Beuvron (Loir-et-Cher).

A new company has lately been formed at Chalons-sur-Marne with a capital of £8,000 and the title La Société Generale Electrique de la Marne, Force et Lumière, to establish an electricity generating station for the supply of current for lighting and power purposes in the Chalons district.

Darlington.—The T.C. has received the sanction of the L.G.B. to a loan of £6,000 for electricity purposes, £5,200 being for mains and £800 for services.

Darwen.—The need for extensions of the Darwen electric light undertaking, in connection with which an application was recently made to the L.G.B. for sanction to borrow £7,600, has been caused chiefly by the increased number of consumers for lighting purposes, and the demand for energy for power purposes, the Corporation having entered into an agreement to supply a further minimum of 120,000 units per annum (probably increased to 150,000 units), to the new colliery now about to be sunk at Hoddlesden, an outlying portion of the borough. Inquiries have also been made by several smaller concerns, who are seriously considering the application of electrical driving to their works, which, if adopted, would mean a further increase of 100,000 units per annum. The principal items of expenditure in the scheme of extensions submitted by the borough electrical engineer (Mr. C. Garnett) are £2,025 for high-tension cables, and £675 for a motor-generator, both being required for the supply to the colliery at Hoddlesden; £1,450 for the provision of services, meters, &c., for new customers; and smaller items for the "strengthening" of three mains which have become unequal to the demand originally anticipated, and for new mains in districts where building developments are taking place.

Dewsbury.—Owing to a breakdown, the Yorkshire Electric Power Co. has applied to the Corporation for a temporary supply of current for the Dewsbury and Ossett tramways. The Corporation has agreed to the supply being given on terms to be arranged.

Dover.—The T.C. has decided to hold an electric cookery demonstration next week.

Dudley.—Additions are to be made to the air and circulating pumps at the electricity works, at a cost of £390.

Dunfermline.—The Lighting Committee recommend that the Town Council should enter into an agreement with the Fife Electric Power Co. for the lighting of Kingseat for a period of 15 years, at £31 per annum.

Ebbw Vale.—The Education Committee has decided to obtain a local estimate for installing the E.L. in the town schools.

Elland.—The question of lighting Huddersfield Road by means of arc lamps has been deferred. The Lighting Committee has resolved that the engineer prepare an estimate for converting the present gas lamps to electric.

Farnham.—Last week the U.D.C. considered the report by the Public Works Committee, upon the proposal to substitute suction gas plant for the steam power at the sewage pumping station. It was stated that the Committee had considered the offer of the Farnham Gas and Electricity Co. to supply the necessary motors and electric current for sewage pumping. Provided the company would reduce their terms from £240 to £210 per annum (which latter amount the Committee estimate as the annual cost of a suction gas plant), and provided an agreement with the company for a term of 10 years could be satisfactorily arranged, the Committee recommended the Council to make the substitution in question. The recommendation was adopted, and it was agreed, failing an agreement with the Gas and Electricity Co., that suction gas be re-considered and also the Diesel engine.

Handsworth.—The annual report of the electric supply department shows a satisfactory year's trading. An increase is shown on the units sold for lighting, heating and power purposes, but as regards traction there is a decrease in units used owing to the reduced service of cars on the Birchfield Road section. The capital expenditure during the year was £1,158, making a total of £74,636. The total revenue from all sources amounts to £8,320, as against £7,812 in the previous year, an increase of £418. Lighting shows an increase of £518, heating and power a decrease of £4 18s.; tramways a decrease of £223, public lighting a decrease of £11 19s., and sundries an increase of £140. The total expenditure on revenue account amounts to £4,152, as against £3,895 in the previous year, an increase of £346. The gross profit for the year is £4,078, which is equivalent to 5½ per cent. on the total capital expenditure, the same percentage as in the previous year. The net result, after deducting from gross profit of £4,078 the loan interest charges £2,752, and the instalment for the redemption of loan £1,881, shows a deficit on the year's working of £555. The profit balance brought forward from last year, as shown in the net revenue appropriation account, was £197, and after deducting from this the deficit mentioned there is a deficit of £357.

Hawes (Yorks.).—For some years the town has been lighted by acetylene gas, but an offer was recently received to light the town by electricity. Two tenders were submitted, one from the gas company and the other from Mr. E. Chapman, the latter offering to provide the district with electric light at a cost of 20s. per week, which was 5s. per week cheaper than the company's offer. After some discussion at a meeting of electors, a resolution in favour of electricity was carried by a large majority.

Herne Bay.—The B. of Trade has extended for a year the E.L. order of the U.D.C., on the understanding that at the end of that period something substantial has been done towards carrying it out.

Holmfirth (near Huddersfield).—A meeting of ratepayers has approved of the scheme of the U.D.C. for providing the district with electricity.

Ilkley.—The D.C. has decided to apply to the B. of T. for a provisional order to supply within the urban district of Ilkley and the township of Myddleton in the rural district of Wharfedale.

India.—The *Indian and Eastern Engineer* quotes a Ceylon paper to the effect that steady progress is being made with the installation of electric light in Nuwara Eliya. The power station at Black Pool is nearing completion, and the laying of the main, which is to convey the water from Lake Gregory to work the turbine, has been completed. The dynamo, turbine and other machinery have arrived, and will be sent up to Nuwara Eliya as soon as the power station building is complete. The posts on which the cables are to be run have been erected along the different routes, and a good length of cable has also been laid. Mr. T. Muttucumaru is supervising the construction works of the power station, and Mr. R. F. Morgan is in charge of the putting up of the posts. Mr. Rylands, Government electrical engineer, pays frequent visits. Nuwara Eliya is expected to be lit up with electricity before the end of the year.

Leigh (Lancs.).—The Corporation is spending £4,589 on an engine, dynamo, condenser and switchboard at the electricity works, and £711 on buildings and steel work. Permission to borrow the money has just been received from the L.G.B.

Lewes.—At a meeting of the T.C. on September 6th, it was recommended that the tender of the Lewes and District Electric Supply Co., Ltd., for lighting 127 public lamps be accepted, and that the contract with the Gas Co. be terminated. There was opposition on the ground that the Gas Co. paid five times more rates than the Electric Supply Co. did, but it was pointed out that the tender of the latter was still from £40 to £50 below that of the Gas Co., who had reduced their estimate by about £90. Ultimately it was decided, by 10 votes to 6, to refer the matter back for re-consideration.

Llandilo.—Mr. Bowen, of Llandrindod, who has been consulted by the U.D.C., has reported that to change the present installation for a Diesel oil plant would cost £900, and for a suction gas plant £600. The capabilities of the present plant, he says, where by no means exhausted, and he advised the Council for the present to allow the engineer to make further improvements. This course has been adopted.

Londonderry.—At a meeting of the Londonderry Harbour Commissioners on Monday, the engineer submitted particulars regarding the proposed installation of electrically-controlled signals on certain lighthouses of Lough Foyle. The matter was referred to a committee.

Melbourne (Derbyshire).—The P.C. has accepted the tender of the Melbourne E.L. and Power Co. for energy for two cluster lamps at 30s. each per annum, and for 26 tantalum lamps at 15s. each.

Porlock.—During the past week a public and private supply of electric lighting has been inaugurated at Porlock, near Minehead, Somerset. The light was switched on by Sir F. Carruthers Gould, the celebrated cartoonist, who resides near. There are two dynamos, one worked by water-power and the other by a Campbell oil engine of 18-24 H.P. Messrs. Crompton & Co. Ltd., were the contractors for the engine, dynamos, switchboard, &c., and the batteries were supplied by the D.P. Battery Co. The main wiring was undertaken by Callender's Cable and Construction Co., Ltd. The whole of the work has been carried out under the supervision of Messrs. J. & W. Purvis, who have been represented by Mr. C. H. Steel.

River Plate.—The *Review of the River Plate* says that the Rosario Electricity Co. is endeavouring to obtain a prorogue of its concession for a further period of 25 to 30 years. This has given rise to considerable opposition, and the general feeling is that the company should make considerable modifications in its tariff if the concession is to be granted. It is maintained that the company has only one tariff for every class of lighting, heating, &c.

Salford.—In a report to the T.C., Mr. T. H. J. Hawkins, the borough electrical engineer, recommends the installation of the following plant, &c.:—Modernised coal-handling plant, £3,100; displace, as required, eight existing boilers by seven of the water-tube type, £14,000; install an additional turbo-generator, £12,500; remove store and fitting shop, and erect travelling crane for turbo plant, £750; erect new fitting shop and store, £1,500; extend switchroom and build new switchboard for power and lighting, £3,500; replace, one at a time, four engine sets of 750 to 900-KW. capacity by turbo-generators of 1,600 KW. each, £50,000; total, £85,350. The increased capacity of the plant would reduce the capital expenditure per KW. from £90 to approximately £54. Of the £85,350, £12,500 could be borrowed for the turbo-generator, and the other £72,850 would have to come from the renewals fund, which, however, only amounts at present to £19,144.

Extra cable connections are to be provided to the generators at the electricity works at an estimated cost of £200.

Simla.—A Bombay paper quotes the *Civil and Military Gazette* to the effect that the engineering works at Basantpur in connection with the Simla hydro-electric installation are making excellent progress. The long flume from Nautikhud to the bank of the Sutlej river is approaching completion, and of the two tunnels which carry the channel through the hills, one is altogether finished and the other has about 120 ft. still to be dug near the end of the flume. A large reservoir is being constructed in which the water of Nautikhud will be collected, and therefrom it will be carried in pipes to the bank of the Sutlej, where there will be a fall of 550 ft. It is this fall of 550 ft., which will supply power to generate electricity for Simla and to pump up its water supply.

Stourport.—On the recommendation of a special sub-committee, the Council has decided to give permission to the Kidderminster and Stourport Electric Co. to supply electric light to Stourport by means of overhead wires.

United States.—Two exhaust steam turbines of 7,500 KW. each have been added to the Commerce Street station of the Milwaukee Railway and Light Co.; they will take steam from the eight vertical cross-compound engines already installed. The installation of two 14,000-KW. high-pressure steam turbines has been begun.

Six gas engines being installed in the new power house of the Indiana Steel Co. at Gary, Ind., are said to be the largest units ever constructed, having a rating of 3,200 KW. each. The engines are of the twin tandem double-acting Allis-Chalmers type, with cylinders 44 in. × 60 in., and will operate on blast-furnace gas, driving alternators delivering 6,600-volt, 25-cycle, three-phase energy to the power network of the Gary mills.

Whitworth.—The General Purposes Committee of the U.D.C. has resolved that the question of electric lighting and power supply be referred to the Tramways Committee for immediate consideration, with authority to invite engineers' reports, &c., and to prepare the fullest report on the matter with a view to exercising the powers already secured.

Wimbledon.—The Town Council has received sanctions from the L.G.B. to the borrowing of £2,993 for high-tension mains; £3,600 for low-tension mains and house services, and £110 for meters. With regard to the sum of £756 applied for by the Council for sub-stations and transformers, the Board has decided to defer its decision on this point until information is received as to what arrangements have been made for the acquisition of sites for the former.

TRAMWAY and RAILWAY NOTES.

Australia.—The *Australian Mining Standard*, just to hand, states that the increase in population in Sydney and suburbs, within recent years, the consequent increase in the number of persons carried by the tramway service, and the fact that the western suburbs are now thickly populated, have necessitated steps being taken by the New South Wales Tramway Department to install more power plant. As showing the demand on the service, Mr. J. Kneeshaw, tramway traffic superintendent, recently stated that, for the year ended June 30th, 1910, there were approximately 187,000,000 passengers carried in the cars, and up to June 30th this year the total was about 230,000,000. The revenue last year was £1,090,000. At present all the electric power generated for the service is obtained from the Ultimo power house; but it is absorbed readily—so much so that on certain special occasions the output has been hardly sufficient to maintain an efficient service. The Ultimo power house is already equipped with an up-to-date plant, but the question of present excess needs and prospective heavy requirements had to be considered. With this end in view, one of two things had to be decided—either to increase the already extensive plant at Ultimo or to establish a new power house which would be absolutely independent of the head station, and at the same time have its own independent tramway service. It was decided to erect a new station, and the site has been fixed at Rozelle, which place is centrally situated in the western suburbs. The proposed plant will be the largest and finest in Australia; it will embrace all the latest improvements known in electrical practice, and all the newest methods introduced into labour-saving appliances. There are to be ten turbo-alternators, with an output of 5,000 KW. each, making a total of 50,000 KW. The complete number of sets is not to be installed at once, but probably when the first five are erected, or are in progress of erection, contractors will be asked to supply the remaining quantity. As yet the work is only in its initial stages, one of which is the calling of tenders for the first five turbo-alternators; these are due to close on October 30th next, and full particulars and specifications are obtainable at the Electrical Engineer's Office, Hunter Street, Sydney.

Ayr.—The working expenses of the Corporation tramways last year, excluding power, amounted to £6,429, or 3·99d. per car-mile, and including power charges, to £8,492, or 5·29d. per car-mile. The percentage of working expenses to receipts was 54. The total number of miles run by the cars during the year was 386,434, and the number of passengers 3,760,746.

Bingley.—The U.D.C. has agreed to meet the Bradford Tramways Committee with reference to the extension of tramway facilities to Bingley, with a view to arranging terms.

Birkenhead.—The Tramways Committee recommended the T.C. to sanction the purchase of six additional cars for the New Ferry route, at an estimated cost of about £3,900. The Council has decided, however, to refer the matter back to the Committee, in order that the type of car may be considered.

Blackburn.—At the T.C. on September 7th, a letter was read from the secretary of the Tramway Men's Union respecting the covering of ends of certain cars as a protection for the drivers against the weather, and as to the brakes on certain cars. The matter was referred to a sub-committee.

Bolton.—The Tramways Committee has had the road at Burnden lowered so that double-decked cars can travel on the Moses Gate, Farnworth and Clifton route, the South Lancs. Co. running in conjunction with the Corporation between Bolton and Clifton.

Colwyn Bay.—It is stated that very good progress has been made with the duplication of the electric car track between Rhos and Penrhynside. Part of the new line is already in use, and the whole scheme will soon be completed.

Continental Notes.—GERMANY.—Reuter's agent at Homburg states that the district committee has adopted a scheme for the construction of a mono-rail railway between Homburg and Königstein, a distance of about seven miles.

AUSTRIA.—The *Financial News* says that negotiations have been opened at Vienna between the Traffic Commission of Vienna and the Länderbank, the Union Bank and the Boden-Creditanstalt, concerning the Vienna Underground Railway, the construction of which, it is estimated, will cost at least 120,000,000 kr.

Didsbury.—The Manchester Corporation Tramways Committee proposes carrying out important extensions in this residential neighbourhood.

Doncaster.—An order made by the Light Railway Commissioners, and confirmed by the B. of T., has just been issued, authorising the construction of a light railway, 4 furlongs 4½ chains in length, in the rural district of Doncaster, at a total cost not to exceed £6,400.

The Corporation has decided to extend the tramway system on the Balby route to Warmsworth, and to include this extension in the application to the B. of T. for power to extend the line to Brodsworth.

East Kent.—The B. of T. has confirmed the order authorising the construction of light railways from Eythorne to Great Mongeham, from Coldred to Maydensole and Stone Hall, and from Eastry to Hammill, in the proposed colliery district.

Edinburgh.—The Tramways Committee of the Corporation has asked the Edinburgh and District Tramway Co. to instruct their drivers to take particular care when rounding curves on the various routes throughout the city.

Glasgow.—At the last meeting the T.C. discussed the proposals—published in last week's REVIEW—in connection with the application to Parliament for a provisional order for power to extend the present tramway system. Numerous objections were intimated, including those from shopkeepers on the proposed route, members of the general public and ward committee, and also from a deputation of carting contractors, to a new route across the river Clyde to the west of the present Glasgow Bridge and up Buchanan Street, demolishing, on the way, the present St. Enoch parish church, and erecting a new bridge across the river. Bailie Russell was inclined to pooh-pooh the opposition, and stated that to his knowledge not 50 per cent. of the shopkeepers in Buchanan Street were antagonistic. He argued that the route proposed was the only feasible one, and on being pressed as to the ultimate cost, estimated the figures at—for construction of track, £22,864; for new bridge, £60,000; and for removing the St. Enoch Church, &c., £13,000. It was agreed not to continue the discussion of the whole of the proposed extensions pending the preparation of a memorandum by the convener, this including the renewed application of ratepayers in Coatbridge to be linked up with the T.C. system.

Japan.—According to the *Daily Telegraph*, public feeling in Tokio has been greatly exercised as to whether the tramways of the city should pass under municipal control. "After much heated argument on both sides, the new arrangement has actually come into force, and the service has begun. The *Jiji*, one of Japan's most influential papers, fears that it will be but the beginning of the wholesale municipalisation programme comprising electric lighting and gas supply, and that the citizens will have to suffer a double burden on account of heavy municipal debts and the increase of the tariff. Electric lighting will be the first to be transferred to the city, for the Tokio Electric Tramways have their own electric lighting department, which the city has to keep up, whether it will or not. There was obviously strong public feeling against the change, for there seemed a general fear that the practical result would be a raising of the fares. After the meeting at which the decision of the city assembly was announced there was fear of rioting, and a force of armed troops of the 2nd Infantry Regiment of the Imperial Guards was stationed in Hibiya Park."

A new electric tramway between Otsuka and Oji, in the suburbs of Tokio, has lately been completed and opened for traffic.

Liverpool.—It was officially announced on Saturday, by Mr. Mallins (general manager), that only 95 of the men who went out on strike remained to be reinstated. A meeting was held on Sunday, under the auspices of the National Transport Workers' Federation, and a resolution was passed demanding the immediate reinstatement of the tramway strikers not yet taken back.

A daily paper reports that on the afternoon of the 5th inst., on the electric line between Sandhills and Bankhall, on the Lancashire and Yorkshire Railway, during shunting operations, the coach of a steam train fouled the metals. It fell over on to the down and up electric lines to Southport, and traffic between Liverpool and Southport was stopped for 1½ hours.

Manchester.—A new scheme of tramway extensions is being brought forward by the City Corporation.

Morley.—The B. of T. has confirmed the order authorising the construction of electric tramways on the overhead system in South Queen Street and Fountain Street, with power to borrow £10,500. A loan of £11,000 is to be applied for, for the construction and equipment of tramways in Bruntcliffe Road and Bridge Street.

Nelson.—The Nelson Tramways Committee has renewed its agreement with the Colne and Trawden Light Railway Co. for another term of through running, and has decided to purchase two more cars.

Plymouth.—At Monday's T.C. meeting Mr. Stephens moved the report of the Tramways Committee, in which there was a recommendation that the maximum wages of all tramway employés be increased by the sum of 1s. a week. Mr. Stephens explained that this was proposed not only because the cost of living had increased, but because the wages were below the amount paid for similar work in other towns. Mr. Willis proposed to add: "and that in addition the drivers of the demi-cars shall be paid an additional 1s. a week." He did this because the men in charge of these cars had to act as conductors as well as drivers. Mr. Stephens promised to bring this proposal before the Committee, but it was seconded. On being put to the meeting as an amendment it was lost, and the minute was agreed to.

South Shields.—The manager of the Corporation tramways has been instructed to prepare a report upon the cost of extending the tramways from the Pierhead to Mowbray Road, and as to the advisability of carrying out the work before next summer.

Wakefield.—The Yorkshire (West Riding) Electric Tramways Co., Ltd., has applied to the B. of T. for consent to the abandonment of the proposed lines from Wakefield to Alverthorpe, and portions in the parishes of Horbury, Ardsley, and from Rothwell to Oulton.

TELEGRAPH and TELEPHONE NOTES.

The "Aerophone."—The lay Press has manifested keen interest during the past week in the doings, and more particularly the sayings, of Mr. H. Grindell Matthews, a "young scientist," "deeply versed in the science of electricity," who claims to have devised a new system of wireless telephony. To call a man a "young scientist" is usually sufficient to damn his chances of being taken seriously by technical men, and when we add that he is said to be in close touch with the War Office, it will be seen that his case is well-nigh hopeless. However, in spite of these drawbacks, we are willing to keep an open mind on the subject of his alleged invention—though the additional facts that he draws inspiration from a recent novel by Miss Corelli, and is convinced that "a great force of energy could be collected from the atmosphere," are not easily condoned. Mr. Matthews claims to have spoken with his system over a distance of 5½ miles, and "hopes to speak 40 miles shortly." We hope he will, too.

Anglo-Belgian Telephony.—The new Anglo-Belgian telephone cable has been successfully laid for the Post Office by Messrs. Siemens Bros. & Co.

Australia.—Mr. H. W. Ramsay-Sharp, the special telephone commissioner appointed to investigate the Sydney telephone system, has furnished another report to the Chamber of Commerce, stating that he had made in all 23 tests, of which 10 were bad—some very bad—three unsatisfactory, and 10 good. Of the 10 bad calls, one occupied 10 min. 18 sec., a second 5 min. 40 sec., another 25 min. 30 sec., others 4 min. 45 sec., and 6 min. 57 sec.

International Telegraph Union Monument.—The international jury dealing with this matter has selected the design submitted by Signor G. Romagnoli, of Bologna; it will be erected at Berne, at a cost of 170,000 fr. It will be remembered that the first competition brought forward no design of sufficient merit for the purpose; the second competition has resulted more satisfactorily.

Long-Distance Telephony.—It is announced that the establishment of direct telephonic communication between Berlin and Stockholm is impending, if it is not already an accomplished fact, by the use of the Egner-Holmstrom microphone. The trials with the apparatus in question are declared to have been successful. Telephonic messages have been exchanged between Stockholm and Hamburg for a long time past, whilst Berlin is already able to communicate with nine Swedish towns.

Pacific Cable.—The report and accounts of the Pacific Cable Board for the year ending March 31st last have been issued, and show that the net traffic receipts were £136,143, making with minor receipts a total of £138,678. The expenditure was £109,343, leaving a balance of £29,334 towards meeting the annuity of £77,544 in respect of interest and sinking fund on the capital of two millions sterling, an increase of £11,378 on the balance in 1909-10. The amount to be provided by the Imperial and Dominion Parliaments to make up the deficiency is, therefore, £48,210 for the past year. Net traffic receipts showed an increase of £24,677, about half of which was due to increase of business.

The Board's repairing ship *Iris* is occasionally chartered by other authorities, and as the extra receipts from this source are irregular and fortuitous, the Board proposes to carry them to reserve account, in order not to disturb the comparison between the ordinary accounts of successive years. The renewal fund stood at £264,236 at the end of the year in question.

No interruption occurred during the year. The Canadian land-line service was taken over by the Board in September last year, with satisfactory results, the average time of transmission between Great Britain and Australia being reduced by 15 to 18 minutes, and the accuracy of transmission being improved.

The forthcoming introduction of a system of deferred messages at reduced rates is mentioned; the P.M.G. has made such progress with the necessary negotiations that there is every prospect that within a few months it will be possible to send messages in plain language at half the existing rates, subject to their being deferred, if necessary, for not more than 24 hours.

The number of international messages handled last year was 129,154, representing 1,849,613 words; there was in addition a considerable inter-Colonial traffic, keeping the Southern sections of the cable fully occupied.

Telephone Transfer.—The Nottingham City Council has agreed to sell to the National Telephone Co. the whole of the wires belonging to the Corporation, which cost £2,600, for £800.

The Dundee Corporation observes that as the Post Office will not pay the taxes that are at present paid by the company, the town will lose £800 a year, besides £200 in wayleaves. The T.C. has taken counsel's opinion as to whether it can take action against the company for breach of contract!

Similarly Bradford Board of Guardians is perturbed at the prospect of losing rates on a value of £4,000, and is asking the Government to continue to pay the local rates, and doubtless other local authorities will follow the same course, with the absolute certainty of meeting with a refusal. Public ownership may not prove all that it has been expected to be—but these things are never thought of till the mischief is done.

Wireless Telegraphy.—Mr. Marconi has just completed the installation of a new wireless station at St. John's, Newfoundland, and direct communication has been opened with England.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—October 3rd. 42 miles of paper-insulated, lead-covered telephone cable, for the P.M.G. See "Official Notices" August 18th.

Western Australia.—October 18th. 20 coin-in-the-slot attachments for the P.M.G. See "Official Notices" August 25th.

November 21st.—One automatic or semi-automatic switchboard and equipment, for the P.M.G.'s Department. See "Official Notices" to-day.

South Australia.—October 25th. Cable and paper sleeves for the P.M.G. See "Official Notices" September 1st.

Tasmania.—October 2nd. Porcelain insulators for the P.M.G. See "Official Notices" September 1st.

Sydney, October 30th.—Five turbo-alternators of 5,000 kw. each, for the New South Wales Government Railways. Full particulars from Electrical Engineer's office, 61, Hunter Street, Sydney. This contract was advertised in the *Sydney Telegraph* of July 29th and the matter is referred to fully in our "Tramway Notes" to-day.

The *Australian Mining and Engineering Review* for August states that the Home Affairs Department will shortly invite tenders for the installation of an electric power plant at the Federal Capital site.

Launceston.—It is stated that Mr. A. G. M. Michell, consulting engineer, Melbourne, has recommended the installation of a horizontal steam turbine, direct coupled to a 300-kw. high-tension three-phase alternator and exciter, and two water-tube boilers, each capable of raising 8,000 lb. of steam per hour at a pressure of 160 lb. per square inch, with superheaters, &c. The cost will be £9,890, and an Australian engineering paper states that tenders for the plant will be invited immediately.

Austria.—September 19th. The authorities of the Austrian Northern Railway, in Vienna, are inviting tenders for an installation of electric lighting at the railway station at Floridsdorf.

The authorities of St. Veit, on the Glan River, in Carinthia, have decided to adopt the scheme of Prof. Wendelin, for the erection of a water power station and the institution of the electric light in the town, and are prepared to consider suitable offers from contractors.—*Der Elektrotechniker.*

September 25th.—Tenders are invited for the supply of 10 1,500-kg. capacity electric cranes and two of 3,000-kg. capacity for the Franz-Joseph Hafen at St. Audrea. Particulars of No. 3388 ex. 1911, K. K. Lagerhäuser, Trieste.

Batley.—Tenders for 3,000 tons of (*a*) best slack (*b*) smudge, for the electricity works.

Belgium.—La Société Nationale des Chemins de Fer Vicinaux, of Brussels (14, Rue de la Science), is inviting tenders for the supply of the electrical connections required for the rails in connection with the light electric railways belonging to the company during the 12 months ending September, 1912.

Birmingham.—September 20th. Coal (85,000 tons), for a year, for the Corporation Electric Supply Department; R. A. Chattock, city electric engineer, 14, Dale End.

Bray (Ireland).—September 19th. 2,500 yd. of concentric, paper-insulated and lead-covered cable, 2,000 volts, for the U.D.C. See "Official Notices" September 8th.

Bristol.—October 2nd. One 10-ton and eight 2-ton high pedestal travelling jib cranes, electrically driven, Royal Edward Dock, Avonmouth, for the Docks Committee of the T.C. W. W. Squire, Engineer, Cumberland Road (returnable deposit of £5).

France.—The Chemins de Fer de l'Etat propose to acquire 450 electric motors for the electrification of the suburban tramways. Particulars from Le Service Electrique, 43, Rue de Rome, Paris.

Halifax.—September 26th. Electrical fittings for six months, for the B.G; A. T. Longbotham, clerk, Carlton Street.

Hastings.—October 18th. Electric lighting of the workhouse, Ore, for the B.G. See "Official Notices" to-day.

Hungary.—The authorities of Mór, in Hungary, have decided to erect a generating station at a cost of 195,000 marks, which will be offered on lease to the constructing firm. Ground will be provided free, the authorities stipulating for three arc and 180 glow lamps.

Keighley.—September 25th. Coal-handling plant, storage reservoir for 200,000 gallons of water, and two circulating pumps, for the Corporation Electricity Works. See "Official Notices" September 8th.

London.—L.C.C.—October 24th. Sub-station plant and machinery. See "Official Notices" to-day.

Hackney.—The Electricity Committee is about to invite tenders for 100,000 pairs of white open-type arc lamp carbons.

September 27th. Extension of the telephone systems at the Guardians' buildings at Homerton. See "Official Notices" to-day.

Stratford, E.—Electric light installation at Artillery House, for the Essex Territorial Force Association. Col. F. F. Johnson, secretary, Bank Chambers, Chelmsford.

Manchester.—September 25th. The Corporation is inviting tenders for electrical machinery, plant, and wiring for Elm Street Cold Storage Warehouse. Specifications and forms of tender from the Superintendent, Markets Department, Town Hall.

October 4th.—One 4,000-4,500 kw. low-pressure exhaust type turbo-alternator, for the Corporation. See "Official Notices" to-day.

Radcliffe.—Proposed new fire alarm system, about £400.

September 18th.—Water softening and purifying plant at the electricity works for the U.D.C. Electrical Engineer.

South Africa.—Port Elizabeth.—October 19th. The T.C. requires tenders for the supply of (*a*) electric motors, and (*b*) electric motor starter panels. Specifications from the Municipal Electrical Engineer. Tenders to Town Clerk.

Spain.—September 20th. The Spanish Ministerio de Fomento, in Madrid, are inviting tenders for the concession for the construction and working of an electric tramway in the province of Guipuzcoa, from El Renteria to the French frontier.

September 29th.—Tenders are being invited by the municipal authorities, of Grazalema, for the concession for the electric lighting of the town during a period of 20 years.

September 30th.—The Ministry of Public Works (Fomento de Obras Publicas), Madrid, is prepared to receive tenders for the construction and working of an electric tram service from Renteria to the French frontier. Deposit, 8,832 pesetas.

York.—September 23rd. Supplies for a year, for the City Electricity Department. See "Official Notices" to-day.

CLOSED.

Australia.—We learn from the *Australian Mining Standard and Electrical Record* that the following contracts have been placed:—For the P.M.G., New South Wales, four electric adding machines (£620), and for the P.M.G., Victoria, two adding machines (£340), from the Burroughs Adding Machine Co.

For Queensland P.M.G.:—

Copper binders, sleeves, tapes, and 15 tons of phosphor-bronze wire at £75 10s. per ton.—Laurence & Hanson Electrical Co., Ltd.
Copper tapes.—British General Electric Co., Ltd.
Galvanised-steel wire.—Webster & Co., Ltd.
5,280 yards of cable, at £185 per mile.—W. T. Henley's Telegraph Works Co.

For the P.M.G., Victoria:—

Earth plates, screws, &c.—I.-R., G.-P. and Teleg. Works Co., Ltd., £144.
Magnets, microphones, &c.—J. Bartram & Son, £428.
Dessicating plant.—Cameron & Sutherland, £135.
350 Duplex translators.—Western Electric Co., £182.
Petrol-driven winch.—Lacy, Hulbert & Co., Ltd., £164.

For the N.S.W. Railway and Tramway Construction Branch, the contract for the welding of steel tramway rails for one year has been placed with the Australian Thermit Co., Ltd.

Blackburn.—The T.C. on September 7th approved of the following contracts:—

Wigan Coal and Iron Co., Ltd.—Steam coal for the electricity works.
Messrs. J. Wright & Co.—Water treatment plant for the electricity works.

Bradford.—The following tenders were recommended for acceptance by the City Council at Tuesday's meeting:—

Messrs. Babcock & Wilcox, Ltd.—Two water-tube boilers, stokers and superheaters, with steam and drain piping and accessories, for Valley Road electricity works, £3,995.
Messrs. Royce, Ltd.—12-ton electrically operated overhead travelling crane, £495.
Messrs. Ferranti, Ltd.—Extra-high-tension switchgear, for Valley Road Works, £295.

Buenos Ayres.—According to the *Review of the River Plate*, the tender of S. Motta for an electric light station at General Paz (province of Buenos Ayres) has been accepted.

Dudley.—The T.C. has accepted the tender of the Worthington Pump Co., at £390, for additions to the air and circulating pumps of the condenser plant at the generating station.

Dewsbury.—An order has been placed by the Corporation with the Union Cable Co. for ¼ mile of ·1, ¼ mile of ·05, and ¼ mile of ·025 cable, at the inclusive price of £126.

France.—The French Post and Telegraph authorities in Paris have just placed a contract with Messrs. Geoffroy & Delore, of that city, for the supply of 500 kilometres of rubber and fireproof cotton-covered copper wire with two conductors, and 70 kilometres with three conductors.

Gateshead.—Messrs. Chamberlain & Hookham, Ltd., have received an order from Gateshead for meters to equip all their cars—namely, 40.

Glasgow.—The T.C. Committee has recommended the acceptance of tenders from the following:—

Double cotton-covered wire.—London Electric Wire Co. & Smith's, Ltd.; and British Insulated and Helsby Cables, Ltd.
Scrap metal, &c., for disposal.—(*a*) Lead: Thos. B. Campbell & Sons, Ltd.; (*b*) copper, (*c*) brass turnings and borings, (*d*) vulcanised cable; R. M. Easdale & Co.

London.—The tender of Messrs. Falk, Stadelmann & Co. has been accepted by the Metropolitan Asylums Board for the supply of "Efesca" lamps to the Grove Hospital.

Nelson.—The T.C. on September 7th considered a report on the improvement of the draught of the electricity works' chimney. The tender of Messrs. Davidson & Co. was accepted for the supply of one 40-in. induced draught fan for fixing on the flue.

Salford.—The T.C. has accepted the following tenders:—

Crompton & Co., Ltd.—Supply and erection of a continuous-current generator at Ladywell Sanatorium, £139.
Johnson & Phillips, Ltd.—Installation of electric light in Health and Water Offices, £124 and £12 for contingencies.
Messrs. Aiton & Co.—For cast-iron discharge pipes for circulating water for the electricity works, at £20.

The Electricity Committee has placed an order with the Clifton and Kearsley Coal Co., Ltd., for 20,000 tons, best washed slack, at 9s. 9d. per ton, and Messrs. Andrew Knowles & Sons, Ltd., for 10,500 tons, best washed slack, at 9s. 10d. per ton.

Stockport.—The T.C. has accepted the following tenders:

Messrs. McClure & Whitfield.—Spare motor, £38 10s.
Dussek Bitumen Co.—Bitumen, £5 10s. per ton.
Messrs. Evershed & Vignoles, Ltd.—Recording meter, £8 16s. 10d.
British Insulated and Helsby Cables, Ltd.—Trolley wire, 32-in. bonds, £8 18s. 6d. per 100; 8-in. bonds, £5 per 100.

War Office.—Messrs. Pritchetts & Gold, Ltd., have received an order from the War Office for a battery for the Royal Military College, Sandhurst.

Wolverhampton.—Subject to the sanction of the L.G.B. being obtained to the necessary loan, the T.C. has accepted the tender of Messrs. G. Cave & Son for the erection of the additions to the electricity generating station, Commercial Road. The Council has also, subject to the same sanction, accepted the following tenders for electrical machinery and apparatus:—

Chloride Electrical Storage Co.—230-cell storage battery, £9,260; maintenance, per annum, £670.
Phœnix Dynamo Manufacturing Co.—Motor-driven boosters, £1,590.
Electric Construction Co., Ltd.—Switchgear and instruments, £1,058; high and low-tension switchgear, £239.
Bruce Peebles & Co., Ltd.—Rotary converter, £1,060.

FORTHCOMING EVENTS.

Electrical Exhibition—Olympia.—Friday, September 22nd. At the Trocadero. At 7.30 p.m. Inaugural banquet.
Saturday, September 23rd.—Opening ceremony at Olympia.

NOTES.

Municipal Tramways Association.—The tenth annual Conference of this Association is to be held in Glasgow, on Wednesday, Thursday and Friday, September 27th, 28th and 29th. After the reception in the Council Chamber by the Lord Provost, Mr. J. Dalrymple, Glasgow's tramway manager, will deliver his Presidential address, and Councillor W. Nelson, sub-convener of the Glasgow Tramways Committee, will read a paper on "The Common Good of the City of Glasgow, its origin, history, and present position in relation to the Tramways Undertaking." After luncheon, Councillor J. H. Rodgers, of Newcastle, will read a paper on "Tramway Finances and Policy," the discussion on which will be opened by Mr. W. J. Squires, vice-chairman of the L.C.C. Highways Committee. In the evening of the first day there will be a dinner in the City Chambers. On Thursday, the meeting of the managers' section will be held in the Newlands Depôt, after which the Conference will resume there at 10.30 for papers, &c. Messrs. R. G. and J. G. Cunliffe, technical assistants to the Manchester Corporation Tramways, will read a paper on "Tramcar Meters," and Messrs. T. B. Goodyer and W. Clough will open the discussion. A report on "Tramway Track: Methods of Construction and Maintenance," by the representatives of Glasgow, Manchester and Leeds Corporation tramways will follow. Light luncheon and the annual business meeting having been duly dispatched, there will at 3.15 be a visit by reserved cars to Rouken Glen, and the Association dinner will take place at 7.45 p.m. at the Grosvenor Restaurant. Friday will be devoted to an excursion to Ayr and the land of Burns. The headquarters of the Association during the Conference will be at the Grand Hotel, Charing Cross. A handbook has been issued giving the foregoing and many other arrangements made in connection with the Congress for the comfort and convenience of members and visitors. Mr. A. R. Fearnley, Division Street, Sheffield, continues as secretary of the Association.

The National Electrical Manufacturers' Association (Incorporated).—The Council of the above Association announces that the proposals for the reorganisation of the work of the Association, which has been in contemplation for some considerable time, and with the details of which members are already familiar, have now been successfully carried through, and will shortly be put into effect. They include the alteration of the title of the Association (which will in future be known as "The British Electrical and Allied Manufacturers' Association, Incorporated)," the appointment of a new secretary, giving his whole time to the work of the Association (vice Mr. F. O. B. Hawes, resigned), and of a larger working staff; the leasing of commodious offices in a central position; certain necessary amendments of the constitution of the Association to meet the new conditions, including the revision of qualifications for members, associate members, and associates; and alterations in the bases of subscription and voting powers. The new Secretary of the Association is Mr. D. N. Dunlop, who is already well known to the industry as the energetic sales manager of the British Westinghouse Co.'s supply department, manager of the publishing department, and superintendent of the Printing Bureau, at Trafford Park, Manchester.

Mr. Dunlop, who was unanimously elected at the meeting of the Council held on the 7th inst., has been empowered, as from that date, to begin the reorganisation of the Association for its new activities, the present secretary's time being entirely engaged in connection with the forthcoming Electrical Exhibition. Mr. Dunlop, whose appointment dates as from January 1st, 1912, will have the hearty goodwill and co-operation of every member of the industry. The present Council of the British Electrical and Allied Manufacturers' Association, and in particular, Mr. Nalder (chairman), and Mr. Longbottom (vice-chairman), are to be congratulated on their success in bringing members to realise the position of advantage which they occupy, and the importance of the work which by their united efforts can be done to enhance the prosperity of the British electrical and allied industries. In wishing the Association increasing success, we commend it to the attention of every manufacturer who has not yet joined.

The Secretaryship of the National Electrical Manufacturers' Association.—In announcing that the above position has now been filled, the Council of the National Electrical Manufacturers' Association (Incorporated) beg to return their best thanks to all those gentlemen who were good enough to respond to their recent advertisement inviting applications for it.

Educational Notes.—BATTERSEA POLYTECHNIC.—The calendar for the new session, which opens on Monday, September 25th, gives full details of the numerous courses and classes held at the institution. In the Day Technical College full time courses are arranged in Mechanical and Electrical Engineering covering a period of three years. Concurrently with the diploma courses, students can take the degree courses in Science and Engineering of the University of London. In addition to the scholarships already existing, the governing body has instituted one of £40 a year for three years, tenable at the Day Technical College. Full evening courses are provided in the Departments of Mechanical and Electrical Engineering, &c. The governing body has arranged a course of lectures on Illuminating Engineering. In the Electrical Engineering Department special attention is being given to the subject of electric traction, and new machinery and apparatus are being purchased in order that the subject may be more fully and thoroughly dealt with. See our advertisement pages to-day.

L.C.C. SCHOOL OF BUILDING (Brixton).—A new departure has been made at this School, in the shape of a special course of lectures on Structural Engineering and Reinforced Concrete, by Mr. H. K. Dyson. The course was inaugurated last winter, and proved so successful that its scope has been extended, and practical work has been added to the lecture course. The session begins on September 18th, and particulars can be obtained from the Principal, Mr. H. W. Richards.

EAST LONDON COLLEGE.—Session 1911-12. Complete courses of instruction in civil, mechanical and electrical engineering are given. See our advertisement pages to-day.

THE POLYTECHNIC (Regent Street).—The new session opens on Monday, September 25th; a special course of lectures will be given by specialists on Illuminating Engineering, and courses in Electricity and Electrical Engineering are provided.

Water-Power in Sweden: The Effects of the Drought.—Although lying so far north, Sweden has been feeling the effects of the general drought, and the dwindling of mountain lakes, streams and waterfalls is having an effect on the working of the electric power stations established at various points. Thus, the power station at Yngeredsfors, in the Varberg district, has had to put the steam reserve station in operation, and the Ramnäs chain works have had to stop working during a portion of the week, owing to the lowness of the water in Lake Kolbäck. This is also the case with the works at Fagersta, Suruhammar and Hallstahammar. The wood-pulp mills are especially affected, and the effect of the partial working which has been occasioned is shown in the prices of wood pulp, which have risen considerably on this account. The latest report is that the power station at Falkenberg has stopped, and the fear is general that this will be followed by further stoppages in many other parts of Sweden. Many of the large rivers in central Sweden are so low that only the most abundant rains can ward off a general disaster.—*Affärsvärlden.*

Electric Power for Bombay Mills.—*Commercial Intelligence* states that the Tata Hydro-Electric Supply Co., Bombay, has received 24 applications from local mill owners for the supply of electric power aggregating about 27,000 H.P.

Train Lighting.—A financial paper quotes the *Frankfürter Zeitung* to the effect that in future passenger cars of the Prussian Railways will be lighted by electric light instead of gas. Each car will be equipped with a dynamo of the Rosenberg patent.

Reunion of Old Cromptonians.—A few of those associated with Messrs. Crompton & Co. in the earlier days have arranged to hold a dinner of Old Cromptonians in London on October 14th next, with the object of giving those who were at one time closely associated, and have since drifted apart, an opportunity of renewing friendships and of spending a pleasant evening. The arrangements are in the hands of a Committee consisting of Messrs. W. A. Chamen, S. Dobson, E. J. Fox, H. M. Leaf, W. L. Pakenham, C. Peel and A. H. Pott, and already some 75 old members have intimated their intention of being present at the dinner. Col. R. E. B. Crompton, C.B., has accepted the Committee's invitation to preside at the dinner, and Mr. W. A. Chamen will act as vice-chairman.

Anyone who has been associated with the firm, and has not already received notice of the dinner, can obtain full particulars by applying to the hon. sec., Mr. E. J. Fox, Winchester House, Old Broad Street, E.C.

International Electrical Congress. — On Sunday last the International Congress on Electrical Appliances was opened. The inaugural address was delivered by Signor Calissano, Minister of Posts and Telegraphs, who was elected honorary president of the Congress. The honorary vice-presidents include the British, American, French, German, Swiss, Belgian and Danish representatives.

At the opening meeting the following were among those appointed to offices in connection with the Congress:—

As Vice-Presidents of the Congress.—Mr. Alexander Siemens, Dr. S. P. Thompson, F.R.S.

As President of the Section of Telegraphy and Telephony.—Major W. A. J. O'Meara, C.M.G, engineer-in-chief, G.P.O.

As Vice-President of the Section for Accumulators and Electrochemistry.—Mr. W. Duddell, F.R.S.

Engineering Exhibition at Baku.—The *Financial News* states on the authority of Dr. P. Dvorkovitz, 1, Broad Street Place, E.C., that the Baku branch of the Imperial Russian Technical Society has decided to organise an international exhibition of internal combustion engines, automobiles, air compressors, electrical motors, &c., to be held next April at Baku, Russia. The exhibition is to be under the patronage of the Viceroy of the Caucasus, and, with the intention of securing the representation of as many British manufacturers as possible, the Russian Government has arranged special concessions. Exhibits will be admitted duty free into Russia, and on the Batoum-Baku Railway line a specially low charge has been arranged, while, after the exhibition, the exhibits will be delivered from Baku to the exporting port of Batoum free of all railway freight charges. The exhibition is to remain open for six weeks; Dr. Dvorkovitz is the official honorary representative.

German Labour Troubles.—A Reuter dispatch from Berlin last week stated that, at a meeting of electricians affiliated with the German Metal Workers' Union, it was decided, by 504 votes to 37, to stop work everywhere on the 5th inst. on the ground that the employers refused to enter into negotiations with the Union for the drafting of an agreement governing a scale of wages.

One Electric Sign in Leeds.—The following notes, culled from a recent issue of the *Southern Electrician* (Georgia, U.S.A.), should provide food for thought to business houses, electrical contractors and supply authorities alike, in Leeds:—

"The city of Leeds is lacking in modern electric display signs. There is only one sign of that order. There are many of the stationary-light style, enclosed or open, but the attractive display signs of most progressive cities are not seen. *Some American concern might find it profitable to develop this field.*" (The italics are our own.)

"The streets of the business section are somewhat narrow and congested, and when stores are closed are dark and dismal in appearance. The electric lighting system is owned by the Corporation, but it does not seem to have sought increased business. The Corporation also owns the gas plant, which may explain a continued use of gas where electricity would be more beneficial."

These two short paragraphs constitute sweeping indictment, much of which is fully justified, though we believe the implied reproach on the staff of the electricity department is undeserved. Confining our attention to the lack of modern electric signs alone, it is surely time that all our great cities took up a form of advertisement which is widely adopted even by the smallest stores in the smallest towns of the States.

Electricity in Agriculture.—It is stated that a portion of the sum of £50,000 a year allotted to the Board of Agriculture by the Development Commissioners for agricultural research will be devoted to experiments on the use of electricity in agriculture. It is to be hoped that the statement is correct, for, in view of the important results already obtained, there are strong grounds for believing that, in many cases, valuable improvements can be effected in the yield of crops.

Absolute Zero—Nearly.—Experiments carried out by Prof. Kamerlingh Onnes on the electrical resistance of mercury, at the very low temperatures obtained when liquid helium boils under reduced pressure, have shown remarkable results. The resistance of the mercury filament used was 173 ohms at 0° C.; at an absolute temperature of 3°, the resistance was less than 3 microhms, suggesting that at absolute zero the resistance would be practically zero. The resistance of constantan, however, remained practically constant between the same limits of temperature.

Honour to Ampère.—In the village of Poleymeux, in the Rhone department, a bronze statue has been set up in honour of Ampère. The inventor is represented standing in an attitude of meditation, the right hand raised to the forehead, the left clenched. On the side is inscribed "La Science," suggestive of the subject of his meditation. The statue has been erected by a committee under the sponsorship of the Association française pour l'Avancement de la Science and other learned societies and local public bodies.—*Revue Pratique de l'Electricité.*

Fatality.—The body of a young electrician named A. Wilson, of the Modder B Gold Mine, was recently found in a drain-pipe hole near New Kleinfontein Gold Mine, Benoni, Transvaal. Alongside the hole was Wilson's bicycle, and it was evident that whilst cycling along the footpath in the direction of the Modder B Gold Mine, Wilson had fallen into this hole and broken his neck.

Manufacturing in Russia.—According to the *Elektrotechniker*, there has been in Warsaw for a number of years a steady inquiry for dynamos of various capacities. It is thought that there is a good opening there for the establishment of a manufacturing branch of a large firm, and enterprising English houses might do well to note the fact.

Institution and Lecture Notes.—At a joint meeting of the Scottish branches of the Association of Mining Electrical Engineers and the National Association of Colliery Managers, a paper was read by Mr. A. B. Muirhead, Lenzie, on "Exhaust Steam Utilisation." The author at the outset submitted that it was not sound policy to keep one more boiler in use at any colliery than was absolutely necessary, even if fuel had little value; that it was a mistake to purchase electrical energy for power purposes, if it could be generated at much less cost on the colliery; and that it did not pay, in many cases, to generate electric power from live steam if exhaust steam was available, and could be utilised for the purpose. He stated that the steam consumption of the mixed-pressure turbine, when using live steam only, would compare favourably with that of the purely live-steam type. If they took a unit of 300-KW. capacity running at 3,000 R.P.M., supplied with live steam at a pressure of 75 lb. per sq. in., and exhausting into a vacuum of 27·5 in., they found the steam consumption in lb. per KW.-hour of "live" and "mixed-pressure" turbines, as under:—

	Live steam turbine.	Mixed-pressure turbine.
Full load	25·7 lb. per KW.-hour.	27 lb. per KW.-hour.
Three-quarter load	28·2 " "	29·5 " "
Half load	31·6 " "	33·6 " "

The following table gave the difference in steam consumption between a purely low-pressure and a mixed-pressure turbine of 300-KW. capacity, with exhaust steam at a pressure of 16 lb. absolute, and a vacuum of 27·5 in.

	Low pressure.	Mixed-pressure.
Full load	34·5 lb. per KW.-hour.	36 lb. per KW.-hour.
Three-quarter load	36·3 " "	38·5 " "
Half load	39·9 " "	43·5 " "

It was generally accepted that this size of unit was somewhat uneconomical in steam consumption, as well as high in first cost, but a marked improvement in both directions had lately been effected. As the undernoted table would show, this size of unit compared very favourably with a totally-enclosed high-speed standard 300-KW. three-crank compound reciprocating unit, supplied with steam at a pressure of 75 lb. per sq. in., and exhausting into a vacuum of 20 in.

Full load	30·34 lb. per KW.-hour.
Three-quarter load...	33·3 lb. " "
Half load	37·9 lb. " "

Finally, a fourth table showed the steam consumption of a 600-KW. mixed-pressure turbine at 3,000 R.P.M. when supplied with live steam at a pressure of 70 lb. per sq. in. and exhaust steam at 16 lb. per sq. in. absolute, exhausting into a vacuum of 28 in. under live steam conditions and 27·5 in. under exhaust steam conditions:—

	Live steam.	Exhaust steam.
Full load	23·5 lb. per KW.-hour	33·8 lb. per KW-hour
Three-quarter load ...	25 " "	36·3 " "
Half load	28 " "	42·8 " "

Fires.—The *Times* states that a telegram was received from Johannesburg on Saturday morning by the London secretary of the Roodepoort United Main Reef Co., stating that a fire in the transformer house caused a stoppage for 10 hours of the battery on Friday, but that now all is working well again.

The *Daily Telegraph* reports that on Monday evening a fire occurred at the London County Council generating station, Prestons Road, Blackwall, where a long gallery, used for conveying electric wires, was damaged before the brigade extinguished the outbreak with one hydrant, a chemical extincteur and sand.

It is reported that at 7 p.m. on Monday, traffic in the Blackwall Tunnel was brought to a standstill through fusion of electric light wires throwing the place into darkness while thousands of workers were wending their way homewards, and while many vehicles were passing through. When the tunnel had been emptied of its groping traffic, police had to guard the entrances at both ends. The reader will probably be able to connect this occurrence with the fire mentioned in the previous paragraph.

The reports regarding the fire which occurred on Monday at the premises of the Imperial Lighting Co. appear to have been exaggerated in the daily Press. We are informed that the fire which occurred at their Pocock Street premises was practically confined to the packing department. The damage was limited to a large quantity of electrical signs and illuminating material, intended for the Delhi Durbar. As the wood-working and other shops escaped with very little damage, all this material will be speedily replaced. The whole of the machinery was running again at midday on Tuesday, and consequently business will be carried on as usual

Appointments Vacant.—Two assistant electrical engineers, for the Government gun-carriage factory, Jubbulpore, and the cordite factory, Aruvankadu, India, respectively (Rs. 280 per month). Junior mains assistant for the Bexley Council Tramways (27s. 6d.). See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Stalybridge, Hyde, Mossley and Dukinfield Joint Electricity and Tramway Board has altered the salary of the general manager, MR. BLACKMORE, from £450 and commission, to £900 per annum, with two annual increments of £50 each, with consulting fees, half of which will be taken by the Board.

MR. CHARLES T. COLE, mains assistant at Dewsbury Corporation Electricity Works, having been appointed to a similar position at Devonport, has resigned. His successor is MR. S. H. FOWLES, of Newcastle-on-Tyne.

The Hackney Electricity Committee recommends that the minimum salary of the works superintendent be £200, rising by annual increments of £10 to £250. MR. T. DALBY at present occupies the position, and has reached the previous maximum of £200 in 1907. Advances are also being granted to MR. E. MATHEWS, testing engineer, and MR. E. WILKINSON, deputy generating engineer.

MR. H. N. WARBURTON, late manager of the Winchester Electricity Works, has presented a clock to MR. W. WILLIS, a member of the staff, as a token of appreciation of his services to the Electric Light and Power Co., Ltd. Mr. Willis is retaining his position under the T.C.

MR. BROWN, of Swindon, has been appointed to the position of chief assistant engineer recently vacant at the Ilkeston Corporation Electricity Department.

Tramway Officials.—The Tramways Committee of the Wolverhampton T.C. has appointed MR. J. OWEN SILVERS, of the Tudor Accumulator Co., Ltd., and formerly of the tramways staff, as tramways engineer and deputy general manager, at a salary of £200 per annum.

MR. HERBERT VICKERS, deputy manager and tramway engineer of the Wolverhampton Corporation Tramways, has been appointed chief assistant and electrical engineer to the Bournemouth Tramways, the vacancy being caused by the promotion of MR. IGNATIUS BULFIN to the general managership, vice MR. C. W. HILL, who has resigned. There were 160 applicants for the post.

On September 7th the marriage took place at Fulwood Road Wesleyan Church, Sheffield, of MR. H. E. YERBURY, son of the late Mr. E. G. Yerbury, of Bath, engineer in the Sheffield Corporation Tramways Department, and Miss Dorothy Elizabeth Wood, younger daughter of Mr. W. W. Wood, of Sandygate, Sheffield.

At Queen Street Church, Morley (Yorks.), on September 7th, the marriage took place of MR. DOUGLAS GRAY, manager of the Keighley Corporation Tramways, and Miss Elsie Mary Rhodes, eldest daughter of the Mayor of the borough, Ald. S. Rhodes.

General.—According to an Australian exchange, MR. G. W. CANSDELL HIRST has been appointed demonstrator in electrical engineering at the Sydney Technical College.

On the occasion of his marriage, MR. W. FOX RATHBONE has been presented by the staff of the Norwich Centre of the National Telephone Co. with fish knives and forks and a case of fish carvers and serviette rings, and by the Tunbridge Wells staff with a silver tea kettle and sugar tongs.

MR. E. E. SHARP, of Messrs. Venner & Co. and Messrs. Chamberlain & Hookham, sails to-day from Liverpool in the ss. *Virginian* for Canada, where he will carry out an extended business tour. Mr. Sharp will also visit the United States and attend the Street Railway Convention in October. We wish him all success and a safe return.

The marriage took place on September 9th, at St. Mark's Church, Wandsworth Common, of MR. P. S. HAWKINS, A.M.I.E.E., chief electrician at the Langham Hotel, and late senior charge engineer at the power station of the Woking Electric Supply Co., Ltd., and Edith Matilda, eldest daughter of Mr. and Mrs. John Miles, of Wandsworth Common.

After nearly four years' connection with the Electrical Co., Ltd., MR. E. O. MULLER is about to join the Electrical Engineering and Agency Co., Ltd., of 109-111, New Oxford Street, in the capacity of a manager for the Motor and Cable Department. He will take up his new duties very shortly.

Obituary.—MR. W. DICK.—The death has occurred at Westcliff-on-Sea of Mr. Wm. Dick, founder in 1874 of the firm of Dick's Asbestos Co., of Canning Town and Fenchurch Street, E.C., Deceased gentleman was 65 years of age.

We regret to state that MR. T. HURRY RICHES, formerly a president of the Institution of Mechanical Engineers, died on September 4th, at the age of 65 years. Mr. Riches was locomotive superintendent of the Taff Vale Railway.

NEW COMPANIES REGISTERED.

Berg, Shepherd & Co., Ltd. (117,425).—This company was registered on August 28th, with a capital of £1,250 in 1,000 6 per cent. preferred shares of £1 each, and 5,000 deferred shares of 1s. each, to carry on the business of electrical engineers, contractors, suppliers of electricity, carriers of passengers and goods, manufacturers of electric, magnetic, galvanic, railway, tramway and other apparatus, &c., to acquire the business carried on at 198, East Road, London, as J. Berg, and to adopt an agreement with J. Berg and F. H. Shepherd. The subscribers (with one deferred share each) are :—B. H. Bourne, 38, Old Jewry, E.C., clerk; A. C. Godsmark, 40, Hailsham Road, Streatham Hill, S.W., clerk. Private company. The number of directors is not to be less than three or more than five; the first are J. Herman, C. A. Lageson, J. Berg and F. H. Shepherd; qualification, £50 shares. Registered by Jenkins, Baker, Reynolds & Co., 38, Old Jewry, E.C.

Oriental M.T.C., Ltd. (117,469).—This company was registered on August 30th, with a capital of £10,000 in £1 shares (4,000 pref., 4,000 ordinary and 2,000 founders') to carry on the business of financiers, concessionaires, bankers, electricians, engineers, suppliers of electricity, &c., and to adopt an agreement with the Radio and Electric Power Co., Ltd. The subscribers (with one share each) are :—A. C. Grover, 102, Fenchurch Street, E.C., accountant; J. E. Burman, 207, Underhill Road, East Dulwich, S.E., clerk. Private company. The number of directors is not to be less than two or more than five; the first are W. J. Van Hoytema and A. C. Grover; qualification, 100 shares. Registered by A. J. Greenop & Co., Bush Lane House, Cannon Street, E.C.

Birmingham Private Telephone (New System) Co., Ltd. (117,443).—This company was registered on August 29th with a capital of £2,500 in £1 shares, to carry on (so far as they lawfully can) the business of makers, sellers, maintainers, and workers of private telephones, telegraphs and electrical apparatus, &c. The subscribers (with one share each) are :—A. Gunz, 19, Livery Street, Birmingham, gentleman; F. T. Jackson, 64, Leadenhall Street, E.C., agent. Private company; the number of directors is not to be less than two or more than five; the first are A. Gunz (managing director and chairman), and F. T. Jackson. Registered office, 12, Livery Street, Birmingham.

Grosart & Kay, Ltd. (7,976).—This company was registered in Edinburgh on August 28th, with a capital of £1,000 in £1 shares, to acquire the business of Grosart & Kay, electrical and engineering merchants, Glasgow. The subscribers (with one share each) are :—W. J. Grosart, 101, St. Vincent Street, Glasgow, electrical engineering merchant; A. E. R. Copeland, 196, St. Vincent Street, Glasgow, chartered accountant. Private company. The first directors are W. J. Grosart and A. E. R. Copeland. Registered office, 196, St. Vincent Street, Glasgow.

Canadian Power Tramways Construction Syndicate, Ltd. (117,482).—This company was registered on August 31st, with a capital of £20,000 in £1 shares, to carry on the business indicated by the title. The subscribers (with one share each) are :—G. Dickson, 20, Lovelace Gardens, Southend, clerk: E. J. Alldis, 18, Macdonald Road, Forest Gate, E., clerk. Private company. Table "A" mainly applies. Registered office, 6, Princes Street, E.C.

Phœnix Telephone and Electric Works, Ltd. (117,562).—This company was registered on September 6th, with capital £50,000 in 49,000 6 per cent. preference shares of £1 each, and 11,800 ordinary "A," and 8,200 ordinary "B" shares of 1s. each, to carry on the business of manufacturers of electrical, mechanical, scientific, and telephonic apparatus and appliances, &c. The subscribers are :—E. J. Reid, 12, Wharf Road, N., engineer, 1,000 preference, and 333 "A" shares; H. Oppenheimer, 6, Chatsworth Road, Brondesbury, N.W., engineer, 1,200 "B" shares: S. Fordsham, 49, Finsbury Pavement, E.C., merchant, 1,000 "B" shares; Mrs. O. Epskin, 6, Milverton Road, Brondesbury Park, N.W., 3,000 "B" shares; Mrs. H. Stoog, Sunnyside, Pierremount Avenue, Broadstairs, 3,000 "B" shares; R. Tayler, 75-76, Lombard Street, E.C., director, 1,000 preference, and 333 "A" shares. Private company. The number of directors is not to be less than two or more than five; the first are E. J. Reid, H. Oppenheimer (chairman and managing director), and R. Tayler; qualification (except H. Oppenheimer), 1,000 preference shares; remuneration of managing director, £500 per annum; of other directors, £50. Registered office, 6, Chatsworth Road, Brondesbury, N.W.

Ingleby & Co., Ltd. (117,463).—This company was registered on August 30th, with a capital of £10,000 in £1 shares, to take over the business of electrical and general engineers carried on by J. C. B. Ingleby, H. S. Ingleby and E. C. Ingleby, at Elland Road, Leeds. The subscribers (with one share each) are :—J. C. B. Ingleby, Woodville, Old Park Road, Roundhay, Leeds, electrical and mechanical engineer; E. C. Ingleby, Woodville, Old Park Road, Roundhay, Leeds, electrical and civil engineer; H. S. Ingleby, Woodville, Old Park Road, Roundhay, Leeds, electrical and civil engineer. Private company. The number of directors is not to be less than two or more than five. The first are J. C. B. Ingleby, H. S. Ingleby and E. C. Ingleby; qualification, £500; remuneration, £15 per annum. Registered office, Elland Road, Leeds.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—A memorandum of satisfaction in full on or before August 15th, 1911, of mortgage debentures dated from September 26th, 1904, to January 28th, 1909, securing £50,000 has now been filed.

C. F. Casella & Co., Ltd. (106,869).—Issue on August 28th, 1911, of £500 debentures, part of a series of which particulars have already been filed.

Warren, Beattie & Co., Ltd. (70,585).—Charge on the company's undertaking and property, present and future, including uncalled capital, dated August 16th, 1911, to secure all moneys for which the mortgagees, as guarantors, may become liable to company's bankers. Holders: Dr. D. Drummond, 6, Savile Place, Newcastle-on-Tyne; and G. Jones, Meadowcroft, West Hartlepool. A memorandum of satisfaction in full on August 16th, 1911, of debentures dated May 7th, 1907, and November 30th, 1908, securing £1,500 and £500, has also been filed.

Metalite, Ltd. (110,919).—Mortgage on freehold hereditaments and premises at Osmaston, Derby, and the company's undertaking and property, present and future, including uncalled capital, dated August 11th, 1911, to secure all moneys due or to become due from the company to London, City and Midland Bank, Ltd.

Electric and General Investment Co., Ltd. (31,506).—Particulars of debentures to secure an amount not exceeding the uncalled capital (£201,500 to date), created August 18th, 1911, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £22,500. Property charged: the company's undertaking and property, present and future, except uncalled capital. The debentures are issued to E. Garcke, of Ditton House near Maidenhead, and J. C. Bull, of 1, Great Winchester Street, E.C., as trustees for the holders of the stock to be created by virtue of the debentures.

T. E. Smith & Co., Ltd. (102,251).—Debenture dated August 29th, 1911, to secure £50, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. M. Smith, 7, Cavendish Street, Keighley.

English Electrical Co., Ltd. (112,639).—Issue on August 29th, 1911, of £750 debentures, part of a series of which particulars have already been filed.

Veritys, Ltd. (49,784).—Return dated July 4th, filed July 6th, 1911. Capital £210,000 in 7,000 5 per cent. cumulative first preference, 7,000 6 per cent. cumulative second preference and 6,980 ordinary shares of £10 each and 200 management shares of £1 each. 7,000 first preference, 7,000 second preference, 5,680 ordinary and 200 management shares taken up. £10 per share called up on 4,670 first preference, 7,000 second preference and 1,480 ordinary, and £1 per share on 30 management. £131,080 paid. £65,470 considered as paid on 2,330 first preference, 4,200 ordinary and 170 management. Mortgages and charges, £58,999.

Siemens Bros. Dynamo Works, Ltd. (88,928).—Return dated June 29th, filed July 5th, 1911. Capital £300,000 in £1 shares. 20,000 shares taken up. £10 per share called up on 7. £70 paid. £199,980 considered as paid on 19,993 shares. Mortgages and charges, £300,000.

Sheerness District Electric Power and Traction Co., Ltd. (65,749).—Return dated June 28th, filed September 4th, 1911. Capital £75,000 in £10 shares (2,500 preference). 5,000 ordinary and 2,473 preference shares taken up. £10 per share called up. £74,730 paid. Mortgages and charges, £15,300.

Trafford Power and Light Supply (1902), Ltd. (72,601).—Return dated June 13th, filed June 15th, 1911. Capital £80,920 in £1 shares (28,120 preference). All shares taken up. £80,920 paid. Mortgages and charges, £54,807 11s. 1d.

CITY NOTES.

German Electrical Companies.

THE E. H. Geist Elektrizitäts Gesellschaft, of Cologne-Zollstock, which decided to go into liquidation last December, is still carrying on business for the purpose of disposing of stocks of raw and semi-finished materials and in anticipation of the sale of the works. According to the accounts for 1910-11, the loss of £24,000, which was ascertained on passing into liquidation, remains unchanged. Since this decision was arrived at, gross profits of £7,200 have been earned, although the amount has been absorbed by management expenses and interest charges. The financial position of the company has improved, and the abundance of orders recently received hold out the prospect of the further working up of the stocks of materials.

The Brandenburg Carbide and Electricity Works Co., of Berlin, which is an amalgamation of the Brandenburg Carbide Works and the East German Water Power Co., reports that the year 1910-11 was characterised by an improvement in the manufacture of carbide of calcium and the supply of electrical energy. As a result of the formation of a syndicate in the carbide industry, as was announced in this journal some time ago, a moderate increase in prices has taken place, although it will only become fully operative when the unexpired contracts at low rates have been completed. The principal portion of the manufacture of carbide was centred at the Krager works of the Norsk Elektrokemisk Aktieselskab, in Christiania, which were constantly fully employed and yielded favourable results; and the Steinbusch Works were used for the same purpose. A portion of the output of carbide was worked up by the East German Nitrogen of Lime Works, of Berlin, the shares in which are held by the company. After referring to the company's electric supply business, the report states that the gross profits amounted to £9,400, as compared with £7,000 in 1909-10. The net profits are returned at £5,700, as contrasted with £400 in the previous year, and it is proposed to pay a dividend of 4 per cent. on the share capital of £175,000, as against no distribution in 1909-10.

The report of Brown, Boveri & Co., of Mannheim, which is the subsidiary of the Swiss firm of the same name, states that the situation of business in 1910-11 was substantially the same as in the preceding year. Although the demand considerably increased, prices continued depressed owing to keen competition, and no indications of any improvement were perceptible at the end of the year. The unfavourable conditions specially affected the chief branch as represented by the construction of turbines. Many firms who had recently taken up the branch endeavoured to find a market under any circumstances, whilst the low prices induced other firms to extend their plant so as to develop the output. This would result in a further depreciation of prices, which had already fallen so low that probably no firm more than covered its prime costs at present. The recognition that large central stations were able to supply power at such low rates that even large establishments found it advantageous to obtain a supply from them, had led to the construction of stations of still greater capacity and the erection of units as large as possible in order to effect economies in the consumption of steam and in attendance. The company had, therefore, taken up the building of steam turbines for outputs of from 15,000 to 20,000 H.P., and the Rhenish-Westphalian Electricity Works had ordered a steam turbine of 22,500 H.P., and the Mark Electricity Works, of Hagen, one of 19,000 H.P. After referring to ship turbines, the report states that the other departments for electrical machinery were also abundantly provided with work, and the construction of small motors had been transferred to the works of the Saarbruck Electricity Co., which had been acquired for the purpose of separating the manufacture of them from the Mannheim works. Activity was also manifested in the improvement of the single-phase motor for traction purposes. The main-line electric locomotive ordered by the Prussian State Railways for the Halle-Bitterfeld section, was almost completed, and negotiations were proceeding in regard to other locomotives. Various railway installations for mines and other transport purposes had been carried out. The accounts show that the sum of £16,000 has been allocated to depreciation, as against £15,000 in 1909-10, and the net profits and balance forward amount to £17,500, as compared with £17,000 in the previous year. It is proposed to pay a dividend of 4 per cent. on the capital of £300,000, being the same rate as in 1909-10.

United Electric Car Co., Ltd., Preston.

THE report of the directors for the year ending June 30th, 1911, expresses regret that during the year there has been a great stagnation in the car-building trade of this country. The directors are pleased to state, however, that the works are now well employed. The works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,367, and charging £5,886 for depreciation, the profit for the year is £4,420, to which is added £4,062 brought from last year, making a total of £8,482; deduct preference dividend for the six months ending December 31st, 1910, £3,000, leaving an available balance of £5,482. The directors recommend that this amount be dealt with as follows:—To pay the preference dividend, less income-tax, for the half-year ending June 30th, 1911, £3,000, carrying forward £2,482. The Hadley and Trafford Park works, which have been an anxiety to the directors for some years past, have now been disposed of. The directors much regret that a loss of £46,171 has been incurred which they propose shall be written off as follows:—From general reserve £10,000; from depreciation reserve £36,171, leaving a balance of £7,329 standing to the credit of the depreciation reserve account.

A Sydney Electricity Supply Company.—The Electric Light and Power Supply Corporation, Ltd., Balmain, Sydney, held its half-yearly meeting in Sydney on August 4th. The directors' report, as abstracted in the *Australian Mining and Engineering Review*, states that the business of the company still continued to expand in a satisfactory manner. The consumers in Balmain totalled 299 and in Newtown 178. An agreement has been entered into with the municipality of Petersham for the supply of electric light and power, and several large applications had been received, and there is a good prospect of profitable business being obtained. Owing to the great increase in the demand for current, the directors had found it necessary to call for tenders for additional machinery, and these would be opened in the course of a few days. The large extension of the company's area of operations, together with the purchase of additional machinery, had necessitated an increase of capital, and a very satisfactory arrangement had been made with the company's bankers for advances from time to time as required up to £25,000, the security for this being a debenture for £25,000, issued subject to the same terms and conditions as the first issue of debentures for £25,000, excepting as to interest, which was to be at the rate current from time to time upon secured overdrafts. The gross profit for the half-year was £2,281. After the deduction of interest on debentures, £1,404, there was put to reserve for depreciation of assets £531, and a dividend at the rate of 5 per cent. per annum absorbed £1,075.

Halifax and Bermudas Cable Co., Ltd.—As summarised in a financial newspaper, the accounts for the year ended June 30th show a profit of £8,168. The directors recommended a further dividend of 2½ per cent., making 5 per cent. for the year, leaving £5,668 to be carried to credit of revenue account, raising it to £26,095 The report was adopted at the meeting held on Wednesday.

British Insulated and Helsby Cables, Ltd.—The directors are reported to have announced an interim dividend on the ordinary shares for the half-year ended June 30th at the rate of 8 per cent. per annum.

National Electric Construction Co., Ltd.—The directors' report states that the accounts for the year to December 31st, 1910, after deducting expenses of admistration, debenture interest, &c., and including £6,322 brought forward, show an available balance of £7,350, which is to be dealt with as follows:—Transfer to debenture redemption fund, £1,550; depreciation on three-wired installations, &c., £644, carrying forward £5,156. The annual meeting was held on Wednesday. Our report will appear next week.

Consolidated Gas, Electric Light and Power Co., of Baltimore.—A dividend of 1½ per cent. on the common shares for the quarter ending September 30th is announced.

South Metropolitan Electric Light and Power Co., Ltd.—The debenture stock register and register of transfers will be closed from September 18th to 30th for the preparation of interest warrants payable October 1st.

Canadian General Electric Co.—A dividend of 1¾ per cent. on the common stock for the three months to September 30th, being at the rate of 7 per cent. per annum, is announced.

Stock Exchange Notice.—The Committee have ordered the undermentioned securities to be quoted in the Official List:—Cuban Telephone Co.—£441,620 5 per cent. first mortgage convertible bonds, Nos. 1 to 598 of £200, 6,501 to 9,413 of £100, 12,501 to 13,553 and 14,501 to 15,000 of £20 each.

MARKET QUOTATIONS.

Wednesday, September 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£10 10	..
a Copper Sulphate	„	£20	..
a Lead, Nitrate	„	£24	..
a „ White Sugar	„	£22 15	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, n casks	per lb.	5½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	68/-	8/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5 5	..
a Soda, Caustic (white 70 %) ..	„	£11	..
a „ Chlorate	per lb.	8½d.	..
a „ Crystals	per ton	£8 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a „ Cyanide (basis 100 %) ..	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£70	..
b „ Wire, in ton lots ..	„	£105	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£88 to £145	..
c Brass (rolled metal 2" to 12" basis	per lb.	7¾d.	..
c „ Tube (brazed)	„	9d.	¼d. inc.
c „ „ (solid drawn)	„	7¼d.	¼d. inc.
c „ Wire, basis	„	7d.	¼d. inc.
c Copper Tubes (brazed)	„	9½d.	..
c „ „ (solid drawn	„	8½d.	..
g „ Bars (best selected) ..	per ton	£71	..
g „ Sheet	„	£71	..
g „ Rod	„	£71	..
c „ (Electrolytic) Bars ..	„	£58	10/- dec.
c „ „ Sheets ..	„	£74	10/- dec.
c „ „ Rod	„	£61	10/- dec.
c „ „ H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	„	5/8	..
f „ Sheet	„	4/9	..
m German Silver Wire	„	1/11	..
h Gutta-percha, fine..	„	8/6	..
h India-rubber, Para fine	„	4/10½	½d. inc.
l Iron Pig (Cleveland warrants) ..	per ton	46.9	3d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Pig	„	£14 12 6 to £14 15	2/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£9 ..	..
d Mica (in original cases) small ..	per lb.	6d. to 2s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large ..	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/0½	..
p „ „ rolled strip & sheet	„	1/1	..
o Platinum	per oz.	172/6	..
e Silicium Bronze Wire	per lb.	6½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£183 to £184	£9 dec.
g „ Wire, Nos. 1 to 18	per lb.	2/1	..
p White Anti-friction Metals ..	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£33	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
p P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Dumbarton Burgh and County Tramways Co., Ltd.—Mr. George Balfour, the chairman, in moving the adoption of the report at the annual meeting held at Edinburgh, stated that the traffic receipts were fully £1,000 in excess of those for the preceding year, and that the increase had been obtained notwithstanding the fact that the receipts were behind those of the previous year until the middle of October. Since then the receipts had shown a very satisfactory increase, and judging from the results since the close of the financial year the improvement would be maintained.

Direct West India Cable Co., Ltd.—A financial daily says that for the year ended June 30th the accounts show a profit of £6,323, out of which the directors recommend a further dividend of 3 per cent., making 6 per cent. for the year, leaving a balance of £4,523 to be added to credit of revenue account, increasing it to £36,249. The annual meeting was held on Wednesday.

Manila Electric Railroad and Lighting Corporation, Ltd.—A dividend of 1¼ per cent. ($1.25 per share) for the quarter ending September 30th has been declared.

STOCKS AND SHARES.

Tuesday Evening.

For weeks past it has been our engaging occupation to write of consistent weakness in the Stock Exchange markets due to trouble abroad, trouble at home, and general want of confidence all round. Unhappily, the tale has still to be continued this week. There are really no fresh reasons to account for the shrinkage in values beyond the fact that the Berlin Bourse has been in the throes of a semi-panic. This, due to the Morocco "incident," as it is politely termed—exercised a most depressing effect upon markets on this side already disposed to flatten for any cause. Recovery of a mild type set in to-day, Tuesday, but the air remains charged with nervousness and uncertainty.

How long this miserable state of affairs is likely to last is a problem we must leave to prophets who have more knowledge than ourselves. It may be remarked, however, that one of the most curious phases in finance is the rapid manner in which confidence returns time after time to the Stock Exchange, however severe may be the blow struck at its base by factors which owe their influence to extrinsic rather than to intrinsic considerations. The cheapness of money is in favour of the Stock Exchange when the foreign political situation becomes more settled, and that prices have been driven down to unduly low levels is as evident, as it is probable they will recover when the atmosphere grows clearer all the way round.

The panic in Berlin already alluded to made itself felt in Electrical stocks and shares through the medium of the Latin-Canadian group. Mexico Trams, Mexican Light and Power, Rio Trams, Canadian Generals, and others of this group are largely held on the Continent. In the offices of the Berlin brokers one usually sees reports, balance-sheets and other literature relating to some of these companies. Hence, in the general bouleversement in Berlin, the prices of these securities got upset with Canadian Pacifics and other issues that have an inter-Bourse flavour. The flatness, however, did not last. Shares offered on behalf of Germany were taken by Brussels as well as London, so that, on balance, the changes are mostly in favour of holders.

For instance, Mexico Trams regained a point after their drop of 3 last week. Rio Trams at 115¾ are ½ higher on the week. Mexican Light and Power Common shows no change, although the price fell at one time to 85, and the Preferred stock is ½ to the good. The company's first mortgage bonds, however, lost a point at 95, and Mexico Tramways 5 per cent. are ¾ lower at 96¾. Rio Tramway Mortgage bonds fell ½, and from these alterations it is obvious that the movement continues to which we have drawn attention several times lately, namely, the realisation of sound investment stocks in order to pay for losses brought about by the fall in more speculative markets.

The Home Railway market has had a very bad week, and prices are not far from the lowest levels from which they started on their big rise which culminated in the latter part of the spring this year. For example, London, Brighton and South Coast Deferred dropped to 92½ on Monday, which compares with the 113½ recorded at the end of April. Other steam stocks followed the same track. Electrical railways, however, have kept comparatively firm. They, of course, have had substantial falls, but, on balance this week, the changes are slight. Central London Ordinary at 67 is a point lower; City and South London at 29½ shows no change. District Ordinary has gained ¼, after its drop of last week, and Metropolitan keeps steady. East London Ordinary is down to 4½, but the four Debenture stocks remain at 98, 40½, 16¼ and 10, for the various issues in their alphabetical order.

The feature in the Telegraph market has been liquidation in Anglo-American Deferred Ordinary, though this had no ultimate effect on balance, while the Preferred is ¼ down on the week. Direct United States are ½ up. The Eastern group holds the improvements registered last week, except that China shares are 2s. 6d. down, and Reuters continue to creep up steadily. West India and Panama are a rather weaker market. Lively dealings in Marconi shares ran the price up at one time to 47s. 6d., took it down again to 45s., and on the week there is no change at 46s. 3d.

National Telephone Deferred shed a point to 117½, business having been marked at 116 this week. The Third Preference keep firm at 5⅛, and the other issues are unchanged. American Telephone and Telegraph Capital stock, in spite of the slump in American Rails, shows a rise of 1, and the only quotable alterations in the South American Telephone descriptions are falls of 1/16 in Oriental Ordinary and United River Plate Ordinary. Anglo-Portuguese Telephone 5 per cent. Debenture stock has started to recover the interest deducted on August 31st, and is a point to the good.

The changes in English electricity supply shares are small, but rather against holders. For instance, Brompton Ordinary and County Preference each lost ½, and Westminsters fell 1/16, while Urban Preference and Edmundson's Preference have not recovered any of the fall of last week. County Second Debenture, however, rose ½, and it is in these Debenture stocks that firmness is chiefly noticeable. The list is exceedingly quiet as a whole, and business remains at a minimum. Nor is there much doing amongst manufacturing shares. Here, again, the difficulty is to find good Debenture stocks yielding a reasonable rate of interest. Castner-Kellner Debenture rose 1½, and for several other issues there are buying orders which cannot be satisfied. Shares, however, are dull. Callender's Ordinary eased off to 9¼. Aron Ordinary shows a loss of 7½d., and a seller of British Westinghouse Preference put the price down to 5s. middle. A hardening tendency in the price of raw rubber is reflected in very steady quotations for the leading rubber shares.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 12th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	7⅞ — 8⅜	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8⅜ — 9⅝	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10 — 10⅝	..	5 14 3
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	..	4 7 5
Brompton & Kensington, Ord.	5	10	10	7⅝ — 8⅛	— ⅛	6 3 1
Do. 7 % Cum. Pref.	5	7	7	7⅞ — 7⅛	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	99 —102	..	3 18 5
Charing Cross, West End & City	5	5	5	3⅞ — 4⅛	..	5 19 2
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅛	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	4½	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 —100	..	4 10 0
City of London, Ord.	10	7	7	12 — 12½ xd	..	5 12 0
Do. 6 % Cum. Pref.	10	6	6	11½ — 12½ xd	..	4 14 1
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 3
County of London, Ord.	10	5	5	7⅜ — 7⅞	..	6 7 0
Do. 6 % Pref.	10	6	6	10⅞ — 11¼	— ⅛	5 6 8
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	100½ —103½	+ ½	4 7 0
Edmundson's, Ord.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2½	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	88 — 86	..	5 4 8
Folkestone	5	5¼	6	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4½ — 5¼	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	8½	9	6⅞ — 7⅛	..	6 2 0
Kensington & Knightsbridge, Ord	5	8	9	6⅞ — 7⅛	..	6 0 0
Do. 4 % Deb.	Stock	4	4	91 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	2	1⅝ — 2	..	3 0 0
Do. 6 % Pref.	5	6	6	4½ — 4⅝ xd	..	6 3 1
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	5	5	3⅞ — 4⅛	..	5 17 8
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	100 —105	..	4 5 9
Do. 3½ % Mort. Deb.	Stock	3½	3½	84⅛ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4	3⅞ — 4	..	5 0 0
Do. 5 % Pref., Non. Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 — 104	..	4 16 2
Notting Hill	10	7½	8	..	..	..
Oxford	5	7	7½	6⅛ — 6⅜	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	8⅞ — 9⅛	..	5 8 1
Do. 7 % Pref.	5	7	7	6⅞ — 7⅛	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord.	5	Nil	Nil	1⅜ — 1⅞	..	Nil
South London, Ord.	4	5	5	2⅜ — 3	..	6 13 4
Do. 5 % First Mort. Deb.	100	5	5	98½ —101½	..	4 18 6
South Metropolitan, 7 % Pref.	1	7	7	1 1/16 — 1 3/16 xd	..	5 17 11
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	5	¾ — 1	..	..
Do. 5 % Cum. Pref.	5	5	5	2 — 2½	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	87½ — 89½	..	5 0 7
Westminster, Ord.	5	10	10	7⅜ — 8	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅝ — 5⅛	— 1/16	4 7 10

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜ xd	+ ⅛	5 6 8
Calcutta, Ord.	5	8	8½	6⅜ — 7⅛	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅜ — 5¼ xd	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	96 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	7	7	105 —110	—2	6 7 3
Do. 7 % Pref.	$100	7	7	121 —125	..	5 12 0
Cordoba Lt., Power and T., Ord.	1	2	3	⅜ — ⅝	..	3 8 4
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	85 — 87 xd	..	5 14 11
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	⅛ — ⅜	..	Nil
Do. 6 % Pref.	1	6	6	¾ — ⅞	..	8 6 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	101½ —103½	..	4 16 7
Madras, Ord.	5	Nil	..	2½ — 3½	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	95 — 97	..	5 8 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	87½ — 89½	— ½	5 11 9
Mexican Lt. & Power, Common	$100	4	4	86 — 88	..	4 10 11
Do. 7 % Cum. Pref.	$100	7	7	106½ —108½	+ ½	6 9 0
Do. 5 % 1st Mort. Gold Bds.	..	5	5	94 — 96	—1	5 4 2
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	88 — 90	— ½	5 11 1
Montreal, Lt., H. and Power	$100	6	7	165 —170	..	4 2 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	39 — 41	..	12 3 10
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101½ —103½	..	4 16 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	4	4	114 —116	..	3 9 9
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	..	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	100 —102	+1	4 8 3
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	Nil	15/16 — 1	+ 1/32	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	105 —107 xd	..	5 12 2

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅜ — 7⅝	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	98½ —100½	..	4 19 6
American Telep. & Teleg., Cap.	$100	8	8	137 —139	+1	5 15 1
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph	Stock	3⅝	3⅝	67½ — 69½	..	5 7 11
Do. 6 % Pref.	Do.	6	6	111½ —112½	— ½	5 6 8
Do. Def.	Do.	25/-	30/-	24¾ — 25	..	6 0 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103 xd	+1	4 17 1
Chili Telephone	5	8	7	6 15/16 — 7⅛	..	4 18 3
Commercial Cable, Stlg. 4 % Deb. Stock	Stock	4	4	87½ — 89½	..	4 9 5
Cuba Telegraph	10	6	6	10¾ — 11	..	5 9 1
Do. 10 % Pref.	10	10	10	17¾ — 18½	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3¾ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8¾ — 8⅞	..	5 14 8
Do. 4½ % Debs.	50	4½	4½	100 —102	..	4 8 3
Direct United States Cable	10	4½	4½	7⅝ — 8⅛	+ ⅛	5 7 5
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	7	137 —140	..	5 0 0
Do. 3½ % Pref. Stock	Do.	3½	3½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	102 —104	..	3 16 11
Eastern Extension	10	7	7	13⅜ — 14	— ⅛	5 0 0
Do. 4 % Deb.	Stock	4	4	100½ —102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	100 —102	..	3 18 5
Globe Telegraph and Trust	10	5⅞	5⅞	10⅝ — 11⅛	..	5 5 7
Do. 6 % Pref.	10	6	6	13 — 13½	..	4 8 11
Great Northern Telegraph	10	18	18	30½ — 31½	— ½	5 14 3
Indo-European Telegraph	25	13	13	56¼ — 58½	..	5 11 1
Mackay Companies Common	$100	4	5	86 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	76 — 78	..	5 2 7
Marconi's Wireless Telegraph	1	Nil	Nil	2⅛ — 2⅜	..	..
Monte Video Telephone, Ord.	1	6	6	⅞ — 1	..	6 0 0
Do. 5 % Pref.	1	5	5	⅝ — ¾	..	5 10 4
National Telephone, Pref.	Stock	6	6	104 —106	..	5 18 2
Do. Def.	Do.	6	6	116 —119	—1	5 0 10
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5 1/16 — 5 3/16	..	4 9 11
Do. 3½ % Deb.	Stock	3½	3½	98½ —100½	..	3 9 8
Do. 4 % Deb.	Do	4	4	98½ —100½	..	3 19 7
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102½ —103½	..	4 7 0
Oriental Telep. and Elec.	1	8	8	1⅜ — 1⅝	— 1/16	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1 1/16 — 1 1/8	..	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 8 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99½ —101½	..	3 18 10
Reuter's	8	5	5	8⅜ — 9½	+ ½	4 3 9
Submarine Cables Trust	Cert.	6	6	132 —135	..	4 8 11
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7⅛ — 7 1/16	— 1/16	5 7 7
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1⅝ — 1⅞	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	98 —100	..	4 0 0
West India and Panama Teleg.	10	Nil	¾	2½ — 2⅞	..	2 14 7
Do. 6 % Cum. 1st Pref.	10	6	6	10⅛ — 10⅝	..	5 12 11
Do. 6 % Cum. 2nd Pref.	10	14½	6	9½ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7	13½ — 14	..	5 0 0
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
Western Union Tel., 4 % Bnds. A	$1000	4	4	107 —110	..	3 12 9
Do. 4½ % Fdg. Bonds	$1000	4½	4½	101 —104	..	4 6 7

* Unless otherwise stated, all shares are fully paid.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 12th.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Bath Trams, Pref. Ord.	1	Nil	Nil	1/16 — 1/8	..	Nil
Do. 5 % Pref.	1	5	5	3/4 — 7/8	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	3/8 — 1/2	..	Nil
Do. 6 % Pref.	10	1½	1½	3 3/8 — 3 5/8	..	3 17 5
Do. 5 % Deb.	100	5	5	93 — 96	..	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	74 — 78	—1	5 15 5
Central London Railway, Ord.	100	3	3	66 — 68	—1	4 8 3
Do. Pref.	100	4	4	85 — 87	..	4 12 0
Do. Def.	100	2	2	49 — 51	..	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1½	29 —30	..	5 0 0
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105	..	4 15 8
Do. Do. 1908	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	11¼ — 12¼	..	4 16 0
Great Northern & City, Pr'f. Ord	10	Nil	Nil	1/8 — 1/4	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	.. ..	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1½	2½	2½ — 3	..	4 3 4
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	Nil	3¼ — 3 3/4	..	Nil
Do. 4 % Deb.	100	4	4	72 — 76	+1½	5 5 3

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 12th.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Metropolitan Railway Consol.	100	1	1½	43 — 43½	..	3 3 3
Do. Surplus Lands	100	2½	2½	64 — 66	..	4 2 4
Do. 3½ % Deb.	100	3½	3½	92 — 4	..	3 14 6
Do. 3½ % Pref.	100	3½	3½	88 — 90	..	3 17 9
Do. 3½ % Con. Pref.	100	3½	3½	87 — 89	..	3 18 8
Metropolitan District Ord.	100	Nil	Nil	24 — 24½	+ ¼	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	Nil	3½	85 — 87	—1	3 14 9
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	29/32 — 1 1/32	..	5 6 8
Do. Def.	1	Nil	Nil	31/32 — 1 1/32	— 1/32	Nil
Do. 5 % Pref.	1	5	5	1 — 1 1/32	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	102 —104	..	4 16 2
Potteries, Ord.	1	2	2	3/4 — 13/16	..	
Do. 5 % Pref.	1	5	5	3/4 — 13/16 xd	..	7 12 4
Do. 4½ % Deb.	100	4½	4½	88 — 91	..	5 18 11
South Metro. Trams, 6 % Pref.	1	3	6	1/2 — 1/2	..	10 8 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 15 5
Underground Elec. Railways 5 % Prior Lien	..	5	5	.. ..	..	4 18 6
Do. 4½ % Bonds	100	4½	4½	98 —100	..	4 10 0
Do. 6 % Income	100	Nil	1	59 — 61	..	1 12 9
Do. Power House Debs.	100	..	4	101 —103	..	3 17 8
Yorkshire (West Riding), Ord.	5	Nil	Nil	1/4 — 3/8	..	Nil
Do. 6 % Pref.	5	Nil	Nil	2 3/8 — 2 5/8	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5 1/16 — 5 5/16	..	5 3 6
Do. 2nd Pref.	5	5	5	4 15/16 — 5	..	5 0 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 8 4
Do. 4½ % Deb.	100	4½	4½	101 —103	..	4 7 5
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 16 2
Bombay Elec. S. & Trams, Pref.	10	6	6	10 3/8 — 11 1/4	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96 3/8 — 98 1/8	..	4 11 5
Do. 5 % 2nd Deb.	100	5	5	97 — 99	..	5 1 0
Brisbane Trams Invt., Ord.	5	8	8	6 3/8 — 7 1/8	..	5 12 3
Do. 5 % Pref.	5	5	5	5 — 5 1/8	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8	137 —141	..	5 13 6
Do. Pref. Ord.	100	6	6	119 —123	..	4 17 7
Do. 5 % Pref.	100	5	5	106 —109	..	4 11 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	101 —104	..	4 6 7
Do. 4½ % Con. Deb.	100	4½	4½	103½ —105½	+ ½	4 5 4
Calcutta Trams, Ord.	5	4½	6	5 3/4 — 6 1/4	..	4 16 0
Do. 5 % Pref.	5	5	5	5 — 5 1/4	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	7/16 — 1/2	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5 3/16 — 5 1/4	..	4 12 6
Do. 4 % Deb.	100	5	5	95 — 98	..	5 2 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 —100	..	5 0 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	Nil	1/8 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	6	6	63 — 67	..	7 9 8

La Plata Elec. Trms, Prf.	1	6	6	1 5/8 — 1 7/8	..	5 13 0
Lisbon Elec. Trams, Ord.	1	5½	5½	1 — 1 1/8	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1 1/8	..	4 16 0
Do. 5 % Deb.	100	5	5	97 —101	..	4 19 0
Madras Elec. Tr. (1904), Deb.	100	5	5	95 — 98	..	5 2 0
Manaos Trams & Lt., 1st Deb.	100	..	5	88 — 91	..	5 9 0
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98 —100	+ ½	5 0 0
Mexico Trams Com.	$100	7	7	117 —119	+1	5 17 8
Do. Gen. Con. 5 % Bonds	..	..	5	5	96 1/4 — 97 1/4 xd	— 3/4	5 2 10
Do. 6 % Bonds	100	6	6	98 1/2 — 100 1/2	..	5 16 8
Para Elec. Rlys. & Lt., Ord.	5	..	10	6 7/8 — 7 1/8 xd	..	6 17 11
Do. 6 % Pref.	5	6	6	5 1/2 — 5 3/4 xd	..	5 6 8
Do. 5 % 1st Deb.	100	5	5	99 1/2 — 101 1/2	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	2½	1 3/8 — 1 7/16 xd	..	3 7 1
Do. 5 % 1st. Deb.	100	5	5	101 1/4 — 103 1/4	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 1/8 — 5 3/8	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	1	4½	115 1/4 — 116 1/4	+ ½	3 17 5
Do. 1st Mort. 5 % Bonds	..	5	5	101 1/4 — 102 1/4	..	4 17 10
Do. 5 % Mort. Bonds	100	5	5	97 1/2 — 98 1/2	— 1/2	5 1 6
Sao Paulo Tram, Lt. and P.	$100	10	10	177 —180	..	5 11 1
Do. 5 % 1st Deb.	$500	5	5	102 1/2 — 104 1/2	..	4 15 8
Singapore Trams, 5 % Deb.	100	5	5	83 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96 1/2 — 97 1/2	..	5 2 7
Un. Elec. Trams Monte Video	5	5	6	5 1/2 — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5 — 5 1/2	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 8
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	107 —109	..	4 2 7

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	Nil	1/16 — 3/32	— 1/32	Nil
Do. 6 % Pref.	1	12	9	7 1/4 — 7 5/8	..	7 7 8
Babcock & Wilcox	1	24	26	5 1/2 — 5 5/8	..	4 12 6
Do. Pref.	1	6	6	1 3/8 — 1 1/2	..	4 0 0
B.I. & Helsby Cables	5	10	10	6 7/8 — 7 1/8	..	6 15 7
Do. Pref.	5	6	6	5 1/2 — 6 1/4	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 97 xd	..	4 12 9
British Westinghouse, Pref.	3	Nil	Nil	1/8 — 3/8	— 1/8	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	102 —104	..	5 15 5
Browett, Lindley, Ord.	1	Nil	Nil	1/6 — 2/-	..	Nil
Do. Pref.	1	Nil	Nil	5/- — 6/-	..	Nil
Brush, Ord.	2	Nil	Nil	1/4 — 3/8	..	Nil
Do. 7 % Pref.	2	Nil	Nil	1/4 — 3/8	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61 xd	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	15	9 — 9¼	— 1/8	7 17 11
Do. Pref.	5	5	5	4 13/16 — 5 1/16	..	4 16 5
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	14	17½	8 3/4 — 8 7/8	..	4 17 0
Do. Deb.	100	4½	4½	103 —107	+1½	4 4 1
Crompton & Co.	3	Nil	Nil	1/4 — 3/8	..	Nil
Do. Deb.	100	5	5	57½ — 67½	..	7 8 2

Dick, Kerr	1	6	5	1 1/2 — 1 5/8	..	5 6 8
Do. Pref.	1	6	6	1 3/4 — 1 7/8	..	5 9 7
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	Nil	1/8 — 1/4	..	Nil
Do. fully paid	5	Nil	Nil	1/2 — 2/3	..	Nil
Do. 4 % Deb.	100	4	4	67 — 71	..	5 12 8
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 8 5
Electric Construction	2	Nil	2½	2 1/4 — 2 3/8	..	6 8 0
Do. Pref.	2	7	7	1 1/4 — 1 1/2	..	7 4 4
Greenwood & Batley, Pref.	10	7	7	7 3/4 — 8 1/4	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8 1/4 — 9	..	5 11 1
Do. Deb.	100	4	4	88 — 93	..	4 6 0
Henley's, Ord.	5	15	15	12 — 12 3/4 xd	..	5 17 8
Do. Pref.	5	4½	4½	4 1/2 — 5 1/8 xd	..	4 5 11
Do. Deb.	100	4½	4½	106 1/2 — 108 1/2	..	4 2 11
India-Rubber, G. & T.	10	10	10	13 — 15	..	6 13 4
Do. Pref.	10	5	5	9 7/8 — 10 1/8	..	4 16 5
Telegraph Construction	12	17½	20	34 — 36 1/2	..	6 11 7
Do. Deb.	100	4	4	100 —102	..	3 18 5
Willans & Robinson	1	Nil	Nil	1/32 — 3/32	..	Nil
Do. Pref.	5	1½	Nil	3/4 — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

* Unless otherwise stated, all shares are fully paid.

Bank rate of Discount 3 per cent., March 9th, 1911.

COAL-CUTTING AND CONVEYING MACHINERY IN MINES.

There is no doubt that those responsible for the introduction of the Eight Hours' Act had some idea that the extended application of machinery for undercutting and handling coal would be accelerated, and make up for the less number of hours worked by the miners, and though this is the proper way of looking at the matter, one very serious consideration must never be overlooked, and that is the price of labour relatively to the selling price of the coal. Now the selling price is fixed by the market, and no coal merchant can say he will not take *less* than, say, 10s. per ton, if others are willing to take—and may be glad to get it—say, 8s. per ton, other things of course, being equal. Very well; then the colliery-owner has to pay out of this all his standing charges, such as rates and taxes, compensation, salaries of the staff, railway charges, royalty charges, dock dues, pumping costs, all machinery and other stores, and wages to the miners, before he can get a penny piece towards any return upon the capital invested in sinking and equipping the mine. As to the actual price of coal at the pit mouth, it may be of interest in passing to quote from the report of Mr. Gerrard, H.M. Inspector of Mines for the Manchester and Ireland District, who says: "Again the owners have courteously enabled me to give the value for almost the whole of the output, the value at the mine having been ascertained for 10,759,581 tons of coal. The values for several years past are :—

1910.	1909.	1908.	1907.	1906.
8s. 10·135d.	8s. 10·308d.	9s. 8·811d.	9s. 0·415d.	7s. 10·14d.
1905.	**1904.**	**1903.**	**1902.**	**1901.**
7s. 8·84d.	7s. 9·93d.	8s. 3·725d.	8s. 3·75d.	10s. 2·67d.

. . . . ." Mr. Gerrard, in fact, gives the prices back to the year 1892, when the price averaged 7s. 6·4d.; but the above are interesting as showing the variation in price, and they will, perhaps, cause the town dweller to wonder why it is that he has to pay so much? This latter point is explained by the fact that the above price is the average obtained for the whole output, including all the various classes of coal. The price obtained for "round" coal will be much higher than that obtained for "nuts," and this again higher than for "small," and so on. Some collieries, in fact—especially those which depend upon the "house" coal trade—may make from five to twenty-five different sizes or classes of coal, to meet the various idiosyncrasies—for they are nothing more—of their customers, which all entails a serious cost to be borne by the colliery-owner.

Wages includes not only the cost of "hewing" or "getting" the coal—though it is this cost which is so much before the public—but also that of removing the coal from the face, hauling it to the pit bottom, winding it to the surface, cleaning and sorting, loading into trucks, and finally handing it over to the railway company for carriage to its destination. The cost of producing and raising to the surface may be anything from 4s. to 6s. or more per ton, and for handling on the surface from 1s. 6d. to 2s. 6d. per ton; hence one district in a mine may pay well, another may only be kept open at the expense of the other; hence very often the colliery-owner's lot is, like the policeman's, "not a happy one." In a hard coal seam the hewing price is, of course, higher than where the seam is soft, but this cost is again influenced by the thickness of the seam, and if the seam is both thin and hard, unless the quality is such that it will command a high enough price, it will not pay to work it. Here, then, is the opening for the introduction of machinery; but the first thing the owner has to consider is the capital cost and the probable return on the outlay. If the price of labour is high, there is a much better chance of securing this return than if labour is cheap and plentiful. The machine merely cuts the coal, after which it has to be got down and filled into tubs, and this can only be done by manual labour. Consequently, we have on one hand the cost of hewing, which is saved, and, on the other, interest on capital cost of machinery, plus cost of power, plus drivers' wages, plus cost of maintenance, and when these are added together it is found there is very little margin, in many cases none at all, and in others there is an actual loss.

As regards the remaining work there will, in all probability, be no saving in getting the coal down and filling, but on what is known as a "long wall" face this cost may be reduced by putting in conveyors so enabling the fillers to easily load the coal, and further reducing the cost of making "gateways" as a fewer number of these will be required. But, here again we have to take into account the capital cost, &c., of the conveyor plant. Finally, as the last advantage in favour of mechanical coal-getting, there will be a larger proportion of "round" coal which will raise the value of the product from the seam. There are, however, other factors which influence the question, such as the state of the roof and floor, whether the seam is troubled with numerous "faults" or "hitches," inclination of the seam, &c.; hence, taking everything into consideration, it is not to be wondered at that coal-cutting has not advanced as quickly as might have been anticipated.

If, however, the miners persist in their demands for a higher rate of wages and get them, as they probably may do, the selling price must increase, and this will increase the margin between the present rate for hand holing and machine holing, and will undoubtedly lead to a great extension of coal-cutting plant.

As regards the present position of coal-cutting plant, the reports of H.M. Inspectors of Mines for last year contain some interesting statistics, from which we extract the following:—In No. 1 District (Scotland) Mr. Walker reports "there is a large increase both in the number of coal-cutting machines and conveyors at work in the district, as compared with the previous year. The increase in the number of machines is no less than 82, and of conveyors 18." The following table shows the number and type of machines at work, together with the quantity of mineral obtained :—

Type of machine.	Number driven by		Statute tons cut.				Number of conveyors at coal face.
			Electricity.		Compressed air.		
	Electricity.	Compressed air.	Coal.	Other minerals.	Coal.	Other min'rls.	
			Tons.	Tons.	Tons.	Tons.	
Disk ...	269	114	3,177,220	45,857*	1,139,903	—	92
Bar ...	137	—	1,295,665	2,051*	—	—	
Chain ...	19	—	96,094	—	—	—	
Percussive	—	41	—	—	115,284	—	
Rotary heading	—	1	—	—	—	1,381†	
Totals ...	425	156	4,568,975	47,908	1,255,187	1,381	
	581		5,873,455				

* Ironstone. † Blacksand, ironstone.

The total output for the district of coal and ironstone was 41,983,547 tons, so that the proportion of machine-mined mineral is about one-seventh. The extra 82 machines were responsible for an increase of 1,403,491 tons. In addition to coal and ironstone, however, there was an output of 758,294 tons of fire-clay and 3,130,280 tons of oil shale, neither of which are machine-mined. There appears, therefore, to be a good opening for a machine to cut the oil shale, if one could be built powerful enough without being unduly massive and heavy. The following table shows the amount of mineral obtained per machine for the various types :—

Type.	Number.	Quantity of mineral.	
		Total for year.	Per machine.
Disk	483	4,362,980 tons	9,033 tons
Bar	137	1,297,716 ,,	9,473 ,,
Chain	19	96,094 ,,	5,057 ,,
Percussive ...	41	115,284 ,,	2,810 ,,
Rotary header ...	1	1,381 ,,	1,381 ,,

Carrying the analysis of the long-wall machines (which includes the first three) a step further, we find that the electrically-driven machines gave an output of about 865 tons of coal per machine more than the compressed-air-driven

machines, which speaks well for the mechanical efficiency of the electric machines, to say nothing of the very much greater increase in transmission and power efficiency, which would be at least 30 per cent. better than that of compressed air. As regards the percussive machines, these can only be driven by compressed air, as there is no satisfactory electrically-driven machine of this type. They are "heading" machines, and, like the rotary header, are only used for "narrow" workings.

In No. 2 District (Newcastle) the machines are only used in the coal mines, the number and type being shown in the following table :—

Type.	Number driven by		Statute tons of coal cut by		Number of conveyors at coal face.
	Electricity.	Compressed air.	Electricity.	Compressed air.	
Percussive	—	209	—	587,588	37
Disk ...	21	38	204,677	328,757	
Bar ...	10	—	140,900		
Chain ...	4	4	56,460	68,695	

Analysing this table, we get as the quantities obtained per machine :—

Compressed-air percussive machines	2,811 tons
Compressed-air disk machines ...	8,651 ,,
Electric ,, ,, ...	9,746 ,,
Average for ,, ,, ...	9,041 ,,
Electric-driven bar machines ...	14,090 ,,
Compressed-air chain machines ...	17,174 ,,
Electric ,, ,, ...	14,112 ,,
Average for ,, ,, ...	15,644 ,,

This is interesting as showing the apparent superiority of the "chain" and "bar" types of machine over the "disk," while each electrically-driven disk produces 1,095 tons more than the compressed-air machine.

In No. 3 District (Durham), Mr. Nicholson reports :—"Compared with the preceding year, there were 25 fewer machines driven by electricity and an increase of nine driven by compressed air. Electrically-driven machines have been taken out at eight collieries, and compressed air substituted in some cases," which is a little difficult to explain, but it looks as though the managers in this district have become somewhat nervous about using electricity in the "coal-face." It is very satisfactory to note, however, that "14 conveyors were used as compared to six in the previous year, and all were worked by electricity except two."

The following table gives particulars of the machines and output :—

Type.	Number driven by		Statute tons of coal cut by		Number of conveyors at coal face.	
	Electricity.	Compressed air.	Electricity.	Compressed air.	Electricity.	Compressed air.
Disk	20	18	194,997	125,423	12	2
Bar	11	11	120,435	105,633		
Chain ...	11	4	38,429	2,256		
Percussive ...	—	44	—	104,046		
Total	42	77	353,861	337,358	12	2

And the following shows the output per machine :—

Compressed-air percussive machines ...	2,364 tons
,, disk machines	6,968 ,,
Electric ,, ,, ...	9,750 ,,
Average for ,, ,, ...	8,359 ,,
Compressed-air bar ,, ...	9,603 ,,
Electric ,, ,, ...	10,949 ,,
Average for ,, ,, ...	10,276 ,,
Compressed-air chain ,, ...	3,439 ,,
Electric ,, ,, ...	546 ,,
Average for ,, ,, ...	1,992 ,,

The average for all the electrically-driven long-wall machines is 8,425 tons per machine, against 7,070 tons for the compressed-air machines, a difference of 1,355 tons per machine in favour of the former. It is only fair to add, however, that these figures may be somewhat misleading, as there was very great industrial disturbance in both this and the Newcastle districts during the earlier part of the year.

That machine mining will take the place of hand holing as the cost of the latter increases, is supported by Mr. Pickering, H.M. Inspector of No. 4 District (Yorkshire and North Midland), who says :—"The increased cost and difficulty of obtaining skilled miners has again resulted in the substitution of coal-cutting machines and conveyors for hand labour. As compared with the preceding year there was an increase of 71 in the number of machines used, and of 542,889 in the number of tons raised. The number of face conveyors increased from 23 to 38." But probably the most important statement is the following :—"No doubt the use of coal-cutting machines and face conveyors working together has a tendency to *reduce* the dangers of falls of roof and sides, for it reduces the number of gate roads and requires systematic work, with the corollary of systematic timbering." The italics are ours, and seeing the largest proportion of accidents in mines is from falls of sides and roof, this statement, coming from such an authority as Mr. Pickering, should not be without effect when the question of introducing machines is being considered.

In addition to coal, "fire-clay" and "ganister" were also cut by machines, so that there should not be any great difficulty in designing a machine to cut the Scotch oil shales, the principal difficulty of which would, no doubt, be encountered in the "clogging" of the cutters. Mr. Pickering, however, does not give the separate quantities cut by each separate type of machine, so that we are unable to compare the work of these for this district. The following table shows the number of machines at work and the total quantity of mineral obtained :—

Type.	No. driven by electricity.	No. driven by compressed air.	Statute tons cut.				Number of conveyors at coal face.
			Electricity.	Compressed air.			
Bar ...	38	24	2,461,861 Coal	2,503,303 Coal	7,193 Fire-clay	18,676 Ganister	38
Chain ...	52	10					
Disk ...	144	148					
Percussive	1	64					

It is interesting to note that one of the percussive machines is electrically-driven, and therefore it would have been all the more interesting if the quantities obtained from each class of machine had been given. There was, however, an increase of 21 electrically-driven machines and 50 compressed-air machines, and the output per machine works out to 10,476 tons each for the former, and 10,176 tons for the latter, showing 300 tons each in favour of electrical machines.

In No. 5 (Manchester and Ireland) District, details of the quantities mined by each class of machine are also not given, but the number of machines is as follows :—

	Disk.	Bar.	Chain.	Percussive.
Electrically-driven ...	3	7	2	—
Compressed air ...	28	3	1	109

The tons cut are : By electric machines, 100,812 ; by compressed-air machines, 405,549 ; and 37 conveyors were at work.

The 12 electric machines cut 8,401 tons per machine, as against 2,876 for each compressed-air machine, the lowness of the latter figure being due to the large proportion of percussive machines.

In No. 6 District (Liverpool and North Wales) there is a decrease in both the number of machines and the output ; there were 10 fewer machines at work and 50,013 less tons were produced than in the year 1909. The number of electric machines, however, increased from 13 to 18, and the reduction of 15 compressed-air machines was due "in a large measure to the stoppage of mines in which coal cutters were employed." The number of conveyors increased from one to five, but four of these were operated by manual labour.

The types of machines employed are as follows :—

	Disk.	Bar.	Chain.	Percussive.
Electrically-driven	8	8	2	—
Tons produced (coal)	37,948	61,392	5,250	—
Compressed air	66	7	1	37
Tons produced (coal)	662,886	165,551	1,673	48,524
Tons per electric machine ...	4,743	7,674	2,625	—
Tons per compressed-air do. ...	10,044	23,650	1,673	1,312

Average for each electric-driven machine ... 5,810 tons
" " compressed-air " ... 7,916 "

The remarkable feature of these figures is the enormous output of 23,650 tons for each compressed-air "bar" type coal-cutter.

In No. 7 District (South Wales) there were :—

	Disk.	Bar.	Chain.	Percussive.	Rotary heading.
Electrically-driven machines	10	34	7	—	—
Tons of coal cut	66,860	205,555	45,600	—	—
Compressed-air machines	6	24	4	20	2
Tons of coal cut	21,826	180,944	5,731	29,887	3,388
Tons per electric machine	6,686	6,046	6,514	—	—
Tons per compressed-air machine	3,637	7,540	1,433	1,494	1,694

Average per electric-driven machine, 6,235 tons.
Average per compressed-air machine, 4,317 tons.

In this case again, the lower average for the compressed-air machines is due to the number of percussive machines with their low capacity. There were 50 coal face conveyors at work.

In No. 8 District (Midland and Southern), in addition to coal, 56,085 tons of ironstone were cut by electric machines, and in the following table this quantity is included in the tonnage given :—

	Disk.	Bar.	Chain.	Percussive.	Rotary heading.
Electrically-driven machines	29	16	10	—	—
Tons produced	349,039	142,061	114,297	—	—
Tons per machine ...	12,036	8,880	11,430	—	—
Compressed-air machines	8	3	3	31	3
Tons produced	109,716	59,560	44,452	64,414	3,102
Tons per machine ...	13,714	19,853	14,814	2,078	1,094

Average for electrically-driven machines, 11,007 tons.
Average for compressed-air machines, 5,859 tons.

Here, again, the compressed-air-driven "bar" type machine scores with an average output of 19,853 tons. Why this should be so is difficult to understand, as the fact that it is driven by compressed air ought to have no bearing on this point, and there is no reason why electrically-driven machines should not to have done equally well. No doubt, however, this point will be made much of by our compressed-air friends. Probably the real explanation is that in both cases where large tonnage is shown the machines were working in soft mineral.

There was only one face conveyor at work in No. 8 District.

It is, of course, impossible to take the above comparative figures as a basis on which the output of any type of long-wall machine may be estimated, but they show clearly that where one type of machine will do well, another type may do very badly ; hence it is very necessary to take into careful consideration all the conditions relating to the seam to be cut. They do, however, show conclusively that electricity is eminently suitable for the work of coal-cutting, and that wherever long-wall machines can be installed they should have preference over the percussive type of machines. In all probability, a machine of the latter type would consume more power with its limited capacity than a long-wall machine with at least five times the capacity for output.

Joints for Flexibles and Hard Wires.—Referring to the article on page 396 on this subject by Mr. D. S. Munro, Mr. Sarsfield W. Martyn sends us some samples of flexibles joined to hard wires with the "M.P." cable connectors, to show how simply and satisfactorily this work can be carried out in accordance with the Institution Wiring Rule No. 53. The connector is about the same diameter as the 3/22 cable, and has a V-shaped vice grip at each end which grips every strand, even all the strands of the flexible. The insulation of the connectors is carried out in the usual way. These "M.P." connectors are made in various sizes, and any of our readers who are interested in this matter can obtain a sample for inspection if they will write to Mr. Martyn, at 11, Pratt Street, Camden Town, London, N.W

REVIEWS.

The Ventilation of Electrical Machinery. By W. H. F. MURDOCH. London : Whittaker & Co. Price 3s. net.

Whenever the transformation, from one form to another, of energy takes place, a certain percentage is inevitably found in a form which is more or less objectionable. In electrical machinery this "lost" energy largely appears in the form of heat, and one of the many problems the designer has to face is this production of wasteful heat. From the point of view of the designer, its objections are many ; by increasing the resistance of the copper conductors it affects the regulation of the machine in an adverse manner, it reduces insulation to matter not very dissimilar from dust, causes bearing troubles, and by expansion effects the buckling of commutators.

The advent of the turbine-driven high-speed generator has rendered this problem a very serious one. Roughly speaking, the output of a generator is proportional to its volume, *i.e.*, to the cube of its linear dimensions, but its radiating qualities are only proportional to its superficial area or the square of its linear dimensions. This fact, of course, accounts for the absolute necessity for the artificial cooling of transformers above a certain output, and while rotating machinery operates under better conditions, in that the windage caused assists the natural radiation in cooling the machine, a point is reached beyond which natural cooling is commercially impossible.

Bearing these facts in mind, there can be no question that a book written specially on the subject of ventilation for electrical machinery is a desideratum.

The book under consideration opens with an algebraic discussion as to the effect of increasing the output above the normal on the efficiency of a machine, and proves that, conditional to the ratio of the constant losses to the variable ones, an overload will improve the efficiency. By means of an adaptation of Fourier's method, it is proved that beyond a certain speed of an enclosed machine, the temperature rise is independent of the speed, which of course is not the case with open-type machines. Other interesting formulæ are worked out by means of elementary differential calculus.

The next section deals with natural cooling. The author gives Poisson's equation for the flow of heat in a fluid, but apparently has not been able to discover any solution of use in the subject under investigation. The reviewer is not surprised at this. There can be little doubt that though it is comparatively easy to form a partial differential equation for a given problem, it is very considerably more difficult to solve it for practical conditions, and the reviewer has found that the converse generally holds for ordinary differential equations. Some good information is given on the Stefan-Boltzman fourth power law of radiation, and so on. The book being written on the lines that it is, Lord Rayleigh's, Sir J. J. Thomson's and Planck's formulæ might have been given and described with advantage.

The following four pages treat of heating and cooling curves, and some interesting curves are given from tests on open, semi-enclosed and closed motors. The flow of heat through insulating coverings is well treated, and some of Dr. Russell's results taken from his important paper before the Physical Society in 1909 are quoted.

The next section discusses the ventilating effect of an armature. Various formulæ are given, and also some experimental data on a 7-B.H.P. variable speed motor. This is the longest and perhaps the best section in the book.

The ventilating action of fans occupies the succeeding 12 pages, three being taken up by dimensions, &c., of a series of fans, while the rest is largely mathematical. This chapter would have been considerably improved had a method of proportioning the blades commonly used on induction motor rotors been given.

The following section enters on a discussion as to the use of a refrigerator as a cooling agent, and the author "is very hopeful that refrigeration may form a useful adjunct to the generator." Personally, the reviewer thinks it will be rather a long time before we find an ammonia or carbonic acid refrigerator used to cool turbo-generators.

The concluding sections deal with practical methods of

ventilating armatures and data for thermal calculations. The former gives some more formulæ, a small amount of description, and six illustrations very obviously of the catalogue type. The data consist principally of four pages of elementary physics.

On page 4 the author states that at the present time the generator output limits the output of the turbine, owing to temperature rise. If by this he means that the turbine can carry larger overloads than the generator, the reviewer concurs, to a certain extent. It is true that, by admitting live steam to the low-pressure blading, enormous overloads can be carried, provided that not only the generator but the condenser can stand it. If generators of greater output are to be connected to existing turbines, then, in many cases, new condensers will be required.

Throughout, the book would have been improved by the inclusion of a fair number of numerical illustrations of the large number of formulæ proved and quoted. On the whole, the book is decidedly good. It gives a large number of methods and ideas, and a designer who possesses sufficient knowledge of elementary mathematical analysis will benefit by a perusal of it.—H.G.S.

Practical Electricity. By W. E. Ayrton, F.R.S. Revised and largely rewritten by T. Mather, F.R.S. London: Cassell & Co., Ltd. Price 9s. net.

Owing to the premature death of Prof. Ayrton, the second of the two volumes, in which it was intended to issue the second edition of "Practical Electricity," was not completed; but it was arranged that the book should be rewritten and published in a single volume of somewhat larger size in the joint names of Profs. Ayrton and Mather. The result is the present work, which deals with the matters treated of in Vol. I of the 1896 edition, as well as those which the second volume was intended to contain. The arrangement of the book follows, in the main, that of the original work, but an attempt has been made to illustrate in greater detail the intimate relations that exist between electrical and mechanical quantities, and to show how the practical system of electrical units is founded on the C.G.S. system of mechanical units.

This mechanicalising of electrical text-books is becoming quite fashionable. Nearly every author claims it as his special prerogative. No doubt there is much to be said for it, but it holds the serious disadvantage that a student must be well up in mechanics before he is able to appreciate the analogy. Still, there can be little doubt that students of electrical science would do well to obtain a good grounding in the principles of applied mechanics, anterior to their study of electricity proper. It must be remembered that human beings have no special electrical sense. We possess senses of heat and cold, lightness and heaviness, &c. We have, from earliest infancy, an intuitive or sub-conscious appreciation of mechanical and physical properties, hence the study of these subjects is simply a matter of tabulating experiences. But when we come to electricity, the human mind is all at sea. It has nothing to work on, and must laboriously analyse and work up its quantitative results with no inborn experience to help. Therefore, the study of electrical phenomena by the aid of mechanical analogy is certainly justifiable, but the method involves some systematic study of applied mechanics in the first place.

The chief features in which the present work differs from the earlier editions are as follows: The experimental proof of Ohm's law is improved by using a zero electro-dynamometer to measure current strengths, instead of a calibrated galvanometer; many new figures and new examples are included; there are new chapters on the potentiometer, on the induction of electric currents, and on the magnetisation of iron. Further space is given to the subject of electric meters; a table of the legal standard wire gauge is printed in an appendix; other tables, giving the number of wires per lineal inch or centimetre, the number of turns of wire per sq. in. or per square centimetre of windings, as well as the resistances per cb. in. or per cubic centimetre for the various sizes of copper wire insulated in several different ways, are added; the "Short History of the Absolute Unit of Resistance, &c.," written by the late Prof. Ayrton, is reprinted and extended by a statement of the work done since 1896, and of the resolutions adopted by the "International Conference on Electrical Units and Standards," held in London in October, 1908.

The book is chiefly intended for students following a first-year lecture and laboratory course in electrical engineering. A good feature is the great number of clear and often novel diagrams. These are beautifully got up, and, for clearness of detail, surpass anything we have seen for a long time. Especially is this conspicuous in the pages dealing with electric meters. Everyone interested in the subject is painfully aware of the usual type of diagram that accompanies description of this kind; of the fearful jumble of parts and connections that it is supposed to illustrate, but in reality only confuses. It is a positive pleasure to examine the diagrams with which this part of the subject is illustrated in the present volume.

The chapter on potentiometer measurements has great merit. The subject is treated in a clear, easy, and logical manner, and the various connections made on the instrument are shown in numerous simple figures, and not all thrown together into one awful mass of intricacy.

That difficult matter for most students, the study of magnetomotive force, is treated in a masterly manner.

Taken all round, the work is all that a student of electrical engineering, in his earlier years, can possibly require.

Engineering Mathematics. By C. P. Steinmetz, A.M., Ph.D. London: Hill Publishing Co. Price 12s. 6d. net.

We are told that this work embodies the subject matter of a lecture course given by the author during a number of years to junior and senior electrical engineering students of Union University.

The object of the author has been to supply a gap that he has found by experience to exist in the teaching of mathematics to engineering students. He considers that for such students some branches of mathematics are of fundamental importance—such as the algebra of the general number, the exponential and trigonometric series, &c.—and that these are seldom adequately treated, and often not taught at all, in the usual text-books of mathematics or in the college course of analytical geometry and calculus.

However matters may be on the other side of the Atlantic, we certainly cannot agree that such a general statement holds good on this side. Within recent years, in this country, there has been much development in the scientific teaching of mathematics. Indeed, in the great technical schools, and to a less degree in the Universities, the teaching of mathematics to engineering students is becoming a fine art. Witness Prof. Perry's book on the calculus, which gave the lead to a host of works aiming to give the budding engineer just the right kind and amount of mathematics necessary for him! Indeed, there is great danger that the thing is, or is going to be, overdone, and that that which, if treated in a spirit of moderation, is a natural process, may become, under the hands of devotees who quickly develop into fanatics, a forced and unnatural one.

However, with these reservations, that we have no dearth in Great Britain of works specially thought out for the mathematical enlightenment of the embryo engineer, and that Prof. Steinmetz's book is certainly not unique here in its objects, it is fair to say that his volume contains information and methods somewhat unusual to see brought under one set of covers.

Chapter I deals with the general number. The first few pages would seem somewhat childish with their illustrations about adding, subtracting and multiplying *horses*, if it were not for the consciousness that a student of *practical* mathematics requires *practical* examples. On arriving at involution and evolution, we begin to understand the process adopted by the author. For instance:—

We have $4 \times 4 \times 4 = 64$;
this is written as $4^3 = 64$,
or, in general, $a^b = c$.

Again—

$$\frac{4^1}{4} = \frac{4}{4} = 1 = 4^0.$$

These results are quite clear, of course, if we have gone

through a general course of mathematics to begin with, but it is doubtful whether such a method of derivation is of much use to a student who starts *ab initio*.

Irrational numbers are treated in the same way.

"Eq. $\sqrt[3]{64} = 4$,

$\sqrt[2]{4} = 2$,

but what is $\sqrt{2}$?

If we attempt to calculate it, we get 1·4142135 . . . ." and so on.

This leads up to a consideration of quantities of the type $2\sqrt{-1}$. Positive and negative quantities having then been dealt with, the way is prepared for a consideration of simple vector diagrams, which aim at giving to negative quantities a sort of concrete existence. An interesting vector diagram of $a^4\sqrt{-1}$ and another of points determined by $\sqrt[n]{-1}$ are given. This portion of the subject is treated in a somewhat novel and convincing fashion, inasmuch as there is given a real meaning to that bugbear of the student of small mathematical attainments, the negative root.

Section B of the first chapter deals with algebra of the general number, and includes rectangular and polar co-ordinates, addition and subtraction, multiplication of general numbers, division of general numbers, involution and evolution of general numbers, and logarithmation. For an example, a long-drawn-out calculation on the steam path in a turbine is worked out.

Chapter II deals with the potential series and exponential function. This is treated in an arithmetical rather than in a strictly mathematical sense, and it must be confessed that this arithmetical illustration gives a more concrete idea of the meaning of convergent and divergent series than the usual symbolical method. Section A of this chapter is general, Section B is on differential equations. This is a somewhat startling jump, and it illustrates the old trouble with mathematics specially designed for engineers. For whereas many pages in the earlier portion of the book are given up to the most elementary stuff and to a prolonged and tortuous leading up to all statements, we arrive at differential equations with great suddenness. There is no preliminary skirmishing. However, with regard to this portion of the subject, the engineer has so much difficulty in finding suitable text-books, that he must welcome the treatment given in the present volume. But let no one be led away with the assumption that he can begin the study of differential equations here. The student must, of course, have a good general knowledge of the calculus, and even of differential equations, before he begins. But granted that he has this general old-fashioned knowledge of the subject, he will find in the present treatment just what he will desire to know, and to know *thoroughly*.

Chapter III deals with trigonometric series; Section A with trigonometric functions, section B with trigonometric series in general, section C with reduction of trigonometric series by polyphase relation; and section D is on calculation of trigonometric series from other trigonometric series. The whole question of series is treated in an extraordinarily extended way, and the man who thoroughly works through this chapter ought to have a first-class knowledge of this important part of his study.

Chapter IV is on maxima and minima, and is illustrated by a great many diagrams and examples from electrical engineering practice. Chapter V is on methods of approximation. Chapter VI deals with empirical curves.

Chapter VII is on numerical calculations, and indicates the best methods to be pursued in attacking any given problem. There are some appendices dealing with general functions, special functions, exponential, trigonometric and hyperbolic functions (the last including functions of real variables, functions of imaginary variables and functions of complex variables), relations among the functions, and tables of exponential and hyperbolic functions.

It will be seen, therefore, that the book rapidly assumes an advanced aspect. The university or technical student who has previously had a good mathematical training, and who wishes to specialise on the mathematics of electrical engineering will, if he has time to go through it thoroughly, find it of much assistance.

THE PREMIUM PUPIL: AN ECHO OF THE CONFERENCE.

By A UNIVERSITY LECTURER.

From July, 1910, to July, 1911, we had, in this country, perfect orgies of conferences. There was the unique effort on the part of the politicians. That—aided by the half-penny Press—made the word conference so familiar that the following few months found all sorts and conditions of men infected with the mania. The writer only attended two—the Imperial Education Conference, held under the presidency of the political expert on education, and the Conference on Engineering Education, for which the Council of the Institution of Civil Engineers was responsible. It is only fair to mention some of the other conferences, because, possibly, they were not all so abortive as the three enumerated. There was the conference on Town Planning, held by the Institution of Municipal and County Engineers. By a grim stroke of humour that was held at West Bromwich, of all places. (You have to know West Bromwich well to appreciate the joke—for if God made the country, and man made the town, then most certainly the devil had a hand in planning some of the towns in the Black Country.) Also the Institution of Naval Architects had a conference, to which our national friends and foes sent delegates, all of whom obligingly informed each other of the special methods which they have evolved for blowing up their rivals, in case of a naval war. Of course there was the Conference of Colonial Premiers, but they only agreed to let the present Government appoint another Royal Commission, which nasty people say is their way of shelving awkward questions. All of these other conferences, however, fade into insignificance before the wonderful effort of that most ponderous of Institutions, the Civil Engineers. As by no stretch of imagination could the Council, collectively, be accused of a desire to be funny, we will suggest that the genesis of the comical farce called a conference on engineering education was something as follows:—

"The Backwoodsmen."

Some of the wild young spirits of the Institution—aged anything from 40 to 60—have been, during the past two or three years, agitating for reform. Somebody even had the astounding temerity to collect signatures for a petition to the Council. Then there were hints in the technical Press that the Institution, as a body, was suffering from senility. Somebody was actually unkind enough to point out the absurdity of some of the examination questions, and the correspondence columns of at least one technical periodical contained protests from those who had been disappointed in the results. (Judging from the knowledge on engineering subjects of some of the candidates the writer has been privileged to successfully coach for the said examination, it passes his understanding how it is that any of those examined can possibly fail.) Things began to look serious when the technical Press began to revolt. Although Mr. Balfour, a politician, may act as Prime Minister, and loftily say that he never reads a newspaper, no engineer could exist if he did not subscribe to the technical Press. Probably you, dear reader, only purchased this admirable journal to scan the "Appointments Open" or "Situations Vacant" columns; but still, you must take in a technical paper if you call yourself an engineer. And, what with the editorials and the correspondence columns, the rumble of the reformers reached the Council table of the Institution. We can imagine that, at first, it caused good-humoured contempt, then some annoyance, and finally a spur to action. What bone was to be thrown to the wolves? Possibly some acute observer said to his fellow-councillors, "Here are young engineers complaining that they are never given an opportunity for discussions, and there are the respectable journals carping because we won't supply them with free 'copy,' as they must not report our papers and discussions. How shall we satisfy these critics? Ah! Capital notion. Engineering education. Let 'em blow off steam on that subject. There will be no lack of speakers and no lack of free copy for the journals." It was a master stroke of genius. The conference was held. We all came together—

the writer was sucked into the maelstrom—and most of those present aired their own views. You may meet engineers who know little about politics, and nothing about religion, but you will never come across one who is not an expert on engineering education. The schoolmaster, the professor, the works manager, the consultant, the director—they all laid down the law. Of course most of the audience only held together in the hope of adding their *ego*. It is only fair to himself for the writer to say that he failed, dismally, to get in a word, and that very probably accounts for his pessimistic view of the whole thing. He waited patiently on to the end, and, as he could not speak, he thought the more. For days, nay weeks, afterwards, the futility of the whole business worried him. Why could not these men agree on some common course of action? It is possible that the reasons are outlined below. They are the only ones that occur to the writer as being feasible.

The Point of the Story.

Man is an argumentative animal, and it may be that engineering education is to the engineer what politics is to the demagogue, or religion to the revivalist. But that is not the moral of the Conference. The great thing which it revealed was the presence of the "No surrender" party. There were present representatives of two diametrically opposed ideals. It was as if the Little Baptists and the High Church party had met together to discuss theology. On the one hand, there were the professors, who want all would-be engineers to attend the colleges. On the other hand, there were the consultants, who want all would-be engineers to find salvation in the premium system. And these latter were, to borrow a political or military metaphor, "Dying in the last ditch." For the premium pupil system is, like another political matter, "Not only doomed, but damned." It is beginning, just faintly, to be recognised that there is an art in teaching. It very often happens that the man who possesses the faculties essential for designing or carrying out a piece of engineering work is quite incapable of writing about it or of teaching students the elements of engineering science. Moreover, the successful engineer is usually a specialist, and the student requires to build his career upon a broad base of principles.

In the whole history of engineering science there is no blacker chapter than that in which is written the history of the training given to some of the premium pupils. Many a parent has paid some hundreds of pounds in order that his son may have the privilege of doing a labourer's work at nothing per hour. Others have paid premiums that their sons may attend an office in Victoria Street to act as a genteel office boy—again at no wage. There are, of course, many cases in which the engineer has conscientiously trained the pupil, but they are badly marred by those in which something very near to fraud has been perpetrated. In support of the contention that the premium pupil in an office often obtains no real training, a reference may be made to the recent circular sent out by the Council of the Institution of Municipal and County Engineers. In it the members were begged to give close attention to the training of pupils, because of the many complaints which had been received about the ignorance of premium pupils who had gone on elsewhere as assistants.

The writer once had a student who had been a premium pupil under a borough engineer. The only thing he seemed to know anything about was the mixing of concrete. He was utterly ignorant of the elements of engineering, or any science, could not use a slide-rule, and was a very bad hand at arithmetic. He was certainly lazy; but the spur of competition with his fellows at college had a useful result.

It seems a fairly obvious thing that the right place to train a man in the scientific principles which underlie all engineering work is a college, and the correct establishment in which the use of tools may be learnt is a factory. It is quite probable that the Professors who attempt to arrange for workshop instruction at colleges make quite as big a hash of that part of the training as do the men who take premium pupils. We have to make many studies in our facilities for training young engineers, especially in the direction of getting them practical experience under commercial conditions, but surely the time has come when somebody should speak out about the iniquities which have existed, and possibly even now exist, under the name of "the premium pupil system." It may be argued that at some of the colleges the students learn nothing. This is said to be the case at institutions where the professors are allowed to run separate consulting offices, and are appointed for any reason except that most essential—the ability to teach. But it is seldom that the student learns nothing. If such is the case, it may unhesitatingly be said to be his own fault. For there is always some member of the staff who will keep the genuine worker busy, and the equipment is always available. In an office there is no equipment, and the "instructor" is usually an engineer who is either too busy or too idle to import much of the knowledge of scientific principles to the pupil.

ERRORS IN METERS.

[FROM OUR LEGAL CONTRIBUTOR.]

There is one question which is frequently a cause of trouble between supply company and consumer—namely, What is the true value of the meter record? Is it final and binding on both parties? To solve the problem, one naturally turns to the Electric Lighting Acts. They shed but a dim light on the question, but apparently meter readings are to be the measure of the consumer's liability; subject to this, that he may have them inspected and tested from time to time. If it can be shown that the meter is wrong, the company puts in a new one, and comes to some arrangement as to what shall be paid for current supplied in the past. There is no reported case which defines the legal rights of the parties with regard to such past supply; and the reason presumably is that the matter is always amicably settled. Whether the meter is wrong or right, is a matter capable of direct ascertainment; the dispute could only be as to *when* it began to register incorrectly.

"The amount of energy supplied by the undertakers to any ordinary consumer under a special order, or the electrical quantity contained in the supply shall, except as otherwise agreed between the consumer and the undertakers, be ascertained by means of appropriate meter duly certified under the provisions of the Special Order, and fixed and connected with the service lines in some manner approved by the Board of Trade." So runs the Statute; and it will be seen that this section leaves it open to the company and consumer to agree as to the method of charging. They are not bound to accept the method of paying by measurement, but may agree together that payment shall be according to the number of lamps used, &c.

The provisions as to the certification of a meter are as follows: A meter shall be considered to be duly certified under the provisions of the Special Order, if it be certified by an electric inspector appointed under the Special Order to be a meter capable of ascertaining the value of the supply within such limits of error as may, as respects meters of the class to which the meter belongs, be allowed by the Board of Trade, and to be of some construction and pattern approved by the Board of Trade, and every such meter is hereinafter referred to as a "certified meter": Provided that, where any alteration is made in any certified meter, that meter shall cease to be a certified meter under the provisions of the Special Order.

An electrical inspector, on being required to do so by the undertakers or by any consumer, and on payment of the prescribed fee by the party so requiring him, shall examine any meter used for ascertaining the value of the supply, and shall certify it as a certified meter if he considers it entitled to be so certified, and the inspector shall, on the like requisition and payment, examine the manner in which any such meter has been fixed and connected with service lines, and shall certify that it has been fixed and connected with the service lines in some manner approved by the Board of Trade, if he considers that it is entitled to be so certified.

Apart from cases which arise between company and consumer, there are but few cases in the law reports concerning

the legal rights of those who make use of electric meters. One case, however, merits attention, namely, Gravesend Tramways, Ltd., *v.* Gravesend Corporation (1910, 74, J.P., 156). It there appeared that the tramway company agreed to take a supply of electric power for its trams from the Corporation. The amount of the current was to be ascertained by the average reading of three wattmeters to be supplied by and to remain the property of the Corporation. The agreement went on :—"Such meters shall be calibrated and fixed in the power station of the Corporation, and shall be connected in a manner to be reasonably approved by the company, and so as to measure the amount of energy actually supplied by the Corporation for use by the company to the switchboard mentioned in the said indenture. . . . Provided that if and when any meter shall show a difference of more than 3 per cent. from the mean reading of the two meters whose readings are the closest, such meter, at the option of either party to this agreement, notified in writing to the other party during the week in which any such difference of more than 3 per cent. shall have occurred shall be disregarded, and shall be removed and recalibrated, or, at their option, the Corporation may provide a new meter in place of that removed, and in the meantime, the amount of electrical energy supplied to the company shall be ascertained by the mean reading of the two remaining meters until such time as the third meter shall have been placed in position. If one of the remaining meters is working manifestly incorrectly, one-fourth of the electrical energy supplied in the last four consecutive weeks in which the mean reading of the three meters was binding and conclusive, shall be considered to be the amount supplied in each succeeding week until the Friday immediately after which three reliable meters had been fixed . . . . the said meters, before they are fixed, and any meter proving unreliable as before mentioned, or any new meter provided in place of an unreliable meter, shall be calibrated or recalibrated by the Board of Trade, or some other independent party to be agreed upon between the Corporation and the company at their joint expense. The company shall pay to the Corporation such a sum per annum as shall be equal to 10 per cent. upon the original cost of providing and fixing three meters."

The agreement also provided that :—"On written notice from one party to the other, the three meters . . . . shall be recalibrated *in situ* by the Board of Trade or by some other approved standardising institution, agreed to in writing between the parties to this agreement, the cost of such recalibration being borne by the party requiring the same."

On several occasions, covering a long period of time, it was found that the meters were inaccurate, and were registering fast as compared with an Aron meter. The plaintiffs contended upon the facts that they were entitled to have three meters installed which were capable of measuring the exact amount of energy consumed by them. They accordingly brought the action, claiming an injunction ordering the defendants to supply three accurate meters. The defendants contended that the plaintiffs were bound by the wattmeters, as and when recalibrated in accordance with the terms of the contract.

Mr. Justice Hamilton, who tried the case, held :—(1) That the meters could not be condemned as long as the remedy by recalibration *in situ* remained open to the plaintiffs; (2) that if the error of any meter could be measured and was constant, and did not arise from any defective adjustment, the necessary rectification of the readings could be made in accordance with ascertained and constant error; (3) that there could not be held to be any breach of any express or implied term of the agreement until the plaintiffs had applied for recalibration and it had been refused; and (4) that the agreement did not amount to a warranty that the instruments installed should measure the amount of energy actually supplied, nor did it impose any express obligation on the defendants to keep the instruments up to the measure of accuracy, which could show the amount of energy actually supplied.

In the event judgment was given for the defendants. This case shows that it is not impossible to devise some form of agreement by which the sole arbitrament of the meter can be avoided in cases where there are large quantities of current passing through the terminals.

TELEGRAPHY WITH SECRET TYPE.

MR. A. N. HOVLAND, Commander in the Norwegian Navy, has, in his capacity as a Naval officer, frequently had the opportunity of observing the different drawbacks of wireless telegraphy, and especially the difficulty experienced in keeping the messages secret, and preventing them from being received by stations for which they are not intended. The most perfect method in use in order to achieve this purpose is that of cryptography, *i.e.*, transforming the usual type into secret type by the aid of a special apparatus, the cryptograph. But although perfect in one sense, this method has the great drawback of being very slow, which prevents its adoption in all cases where speed is a necessity.

With the view of obtaining some better means, especially in connection with the use of wireless telegraphy for military purposes, Mr. Hovland in 1907 got the idea of transforming telegrams from the usual type into secret type automatically, acting on the fundamental principle that it would be of no particular consequence whether stations not concerned were receiving messages, if it only

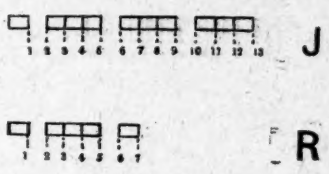


FIG. 1.

were possible to prevent them from deciphering them. He then constructed an apparatus with a keyboard, by means of which it became possible to send messages and simultaneously transform the type into secret type automatically. But this represented only the solution of the problem of transmitting, not of receiving.

In 1907 the inventor succeeded in obtaining the necessary financial support, after which he commenced the construction of a combined transmitting and receiving apparatus. The experiments, which were carried out with this apparatus for line telegraphy, gave very good results, and all anticipations were perfectly justified.

The system comprises three main principles, viz. :—

1. The idea of transforming ordinary type into secret type, and *vice versâ*.

2. The idea, by means of those impulses which are sent by wire or by radio-telegraphy, of recording the corresponding Morse letters at the receiving station by means of an arrangement with metal type instead of by means of ink or colours.

3. The idea of producing printed letters by means of these metal types in the following manner :—

A number of series of sparking gaps are arranged above each other, which, in each series, are arranged like Morse letters. Passing over these series the Morse letter will continue until reaching its own letter, formed by the said gaps. When this takes place an electric circuit is closed and the type is printed.

The aforesaid ideas are comprised in the chief patent claim, which briefly expresses the method to be : "A receiving system, according to which it becomes possible by a combination of short or long impulses of the current to carry out any number of various actions at a distance, as, for instance, the typing of letters, steering of torpedoes or ships, firing mines or torpedoes, producing certain acoustic, optical or electrical signals, drawing maps, charts, &c."

As space does not permit of giving a detailed description of the latest improved apparatus, the following will be limited to a brief description of the second apparatus, by means of which the inventor succeeded in realising his ideas and methods.

The object of the construction of this apparatus was :—

1. The printing of radio-telegrams on the tape with ordinary type instead of secret type.

2. The solution of the problem with the aid of one wave-length, by means of which it would be possible to take advantage of sharp tuning.

3. To make the apparatus adaptable to all systems of wireless telegraphy.

He first divided a Morse letter into different impulses, taking the dots and the spaces into account as 1 unit of time, and the dashes as 3 units (see fig. 1).

He then had the Morse letters cast into metal type, which were arranged and placed in a frame as shown in fig. 2; underneath the type was placed a moving electromagnet, by the aid of which the type might be pressed upwards.

When the electromagnet now is moving with uniform speed, and impulses are regularly conducted through its winding, it becomes possible to get any Morse letter printed, provided only that there are 17 metal pieces.

With the view of transforming the Morse code into ordinary type, a series of contacts and gaps were arranged so as to form Morse letters. By connecting these series with conductors, an electric battery and an electromagnet, the circuit was closed when any of the metal letters was made to pass the gaps. In this case it is, however, assumed that the metal type would close the circuit through all the gaps in the series in question. If not, no effect whatever would be produced.

As shown in fig. 2, the letters have been arranged according to their lengths, so as to prevent more than one, and that the right one, from being printed. The type R, for instance (. — .), may

be conveyed under the long series without being able to close the circuit before reaching the corresponding letter; but, arrived at its destination, the circuit closes and the letter R is printed by the electromagnet on the tape, after which the circuit is broken automatically. If this did not happen, the metal type would pass on,

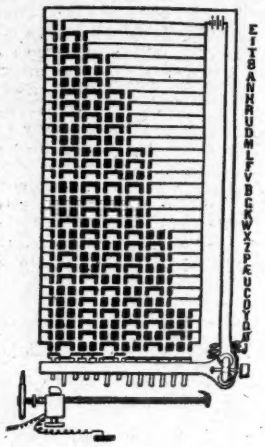


FIG. 2.

the result of which would be the printing of all shorter signs, the gaps of which it would be capable of covering.

The Morse code is by no means the only system adaptable, and any other system may be used. The one used in the first apparatus constructed was adjusted to a number of impulses equal to seven, while one based on a principle of four impulses maximum, two auxiliary and one immobilisation impulse, has been adopted for the latest construction. The principle, however, is the same, the difference depending only upon the construction.

In fig. 3 is shown the combined transmitting and receiving apparatus, which was constructed in 1907, and in figs. 4 and 5 a schematic drawing is given of each apparatus separately.

The most characteristic feature of this apparatus (fig. 3) is this: that the above-mentioned contact series have been arranged around a drum in such a manner that each series forms a separate piece of metal, which can easily be removed and replaced. By means of this arrangement it was made possible to obtain an interchange of

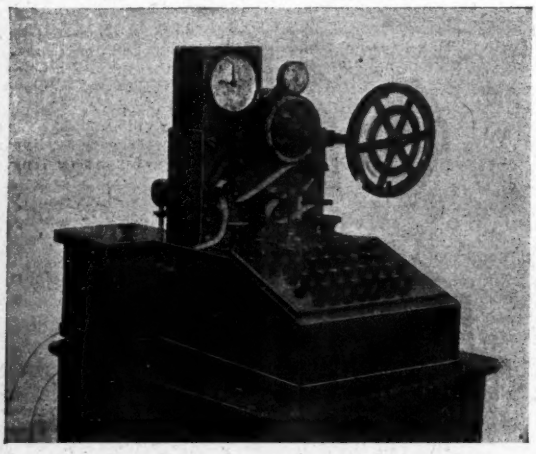


FIG. 3.

the long and the short signs, in order to produce secret type. The type wheel might also be turned round its axle, and thereby it became possible to place different letters opposite to the various Morse signs on the drum. The slightest turning of the type wheel might thus cause secret type to be produced.

An electromagnet served to push upwards the metal pieces or contact brushes, of which the Morse sign was formed. It also acted on a movable stop, fixed to a metal piece, which was kept moving with uniform speed along the underside of the other metal pieces by means of worm gear. The mechanism which worked the contact arm of the transmitting apparatus was driven by the exterior end of the worm.

In fig. 4, *a* represents the worm, *c* the contact arm, moving above a ring with eight metal segments insulated from each other. These are connected with the contact springs *d*, which are placed underneath the keys A B C D, and each key has thus a separate contact arrangement, which forms a special sign.

The connections may be seen from the drawing. If a key is pressed so as to bring it into contact with the springs *d*, the contact arm *c* will be coupled to an axle by means of a special mechanism. This axle is kept in constant rotation by the toothed wheel *b* and the worm *a*, and the contact arm will move round once, thereby brushing the ring of contacts.

When the key A is pressed, the segments Nos. 1, 2, 3, 6 and 7 will be charged, and it may be seen that an electric current will be admitted through the electromagnet *g* each time the arm *c* passes a live segment, and each time the key will be attracted and send an electrical impulse through the transmitting arrangements placed underneath the key, through which a short wave train will be transmitted into space.

If A is pressed, electromagnetic waves will radiate in the three first units of time, as well as in the sixth and seventh, while there is an interval for the fourth and fifth units of time, and segment No. 8 is only the resting segment.

When the arm *c* returns to its starting point, it is automatically disconnected, and comes to rest.

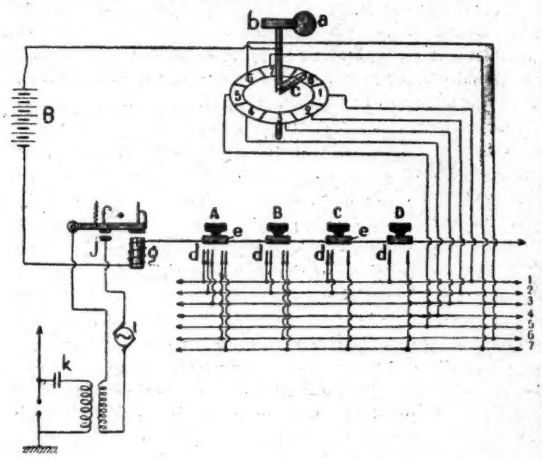


FIG. 4

Fig. 5 shows the receiving apparatus. The drum *c* consists of the aforesaid contact series, easily interchanged. By means of the contact rings *a* and *b* and springs, these contact series are connected with the electric battery B_1 and the magnet E_1.

The frame *h* carries six metal pieces, which are used for the purpose of forming the Morse signs.

The endless screw which moves the electromagnet *j* is driven by a small electromotor, and must be kept running continually and with uniform speed at all the stations which are working together. The speed can at any time be read from an indicator, which is seen on the top to the left in fig. 3. Under the screw are seen the wireless receiving apparatus with their coherers and relays.

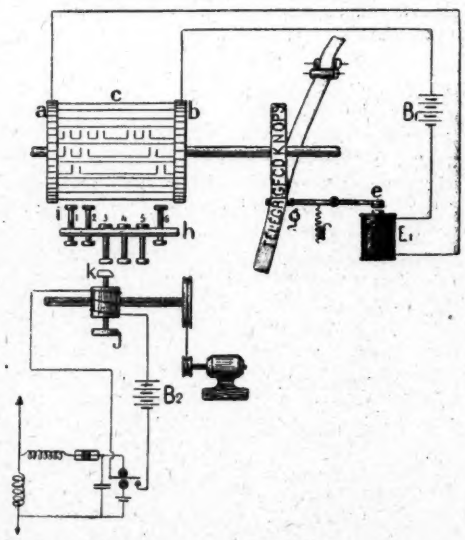


FIG. 5.

The impulses which are transmitted from the sending station act on the coherers and relays of the receiving station in such a way that the armature of the magnet is attracted, thereby causing the hammer *k* to push up the metal pieces *i*.

The electromagnet *j* remains in its position of rest at one end of the screw up to the moment when the first impulse arrives; but then it commences to move along the screw.

Arrived at the other end, the electromagnet is liberated and pushed back to the original position by means of a spring.

Experiments with this apparatus were carried out over a distance of about 12 miles between the two stations of Melsomvik and Tjömö, and although a considerable number of difficulties had to be overcome, the final results turned out very satisfactory. The

principle had been proved to be suitable for practical purposes in respect of line telegraphy, and the question now was to adapt the principle to radio-telegraphy, for which purpose two new apparatus were constructed. Essential features of these new apparatus were that they should be as plain and simple as possible, so as to facilitate the introduction of wireless on merchant ships and fishing vessels, &c.

The questions of ease of regulation of speed and synchronism were those which chiefly had to be considered, on account of the difficult problems in connection with them. It was imperative that two ships, for instance, should be connected at once, without first having to waste time with tuning and adjusting their apparatus.

This problem was solved by letting the contact-arm only make one revolution for each letter, simultaneously at both stations.

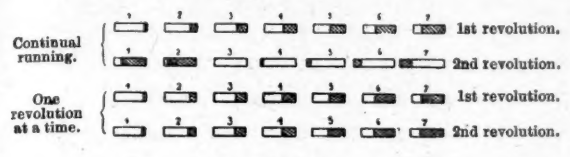


FIG. 6.

The two upper lines in fig. 6 represent the impulses of current of two apparatus, which are kept constantly moving with a certain fixed speed.

Assuming that the difference in speed amounts to 7 per cent., the one apparatus at the seventh impulse will be seven-tenths of an impulse behind the other. They have still three-tenths of an impulse in common, but in the second revolution the difference of 7 per cent. at the third impulse will prevent any further working.

The lower series in fig. 6 show the impulses for two apparatus, the contact-arms of which only make one revolution, while the difference in speed is 7 per cent.

After the first revolution the one apparatus will be seven-tenths of an impulse behind the other; but having passed the seventh impulse, the contact-arms stop, and the error is reduced to nil.

After each subsequent revolution the error is thus eliminated, and the apparatus may continue to work together in spite of the difference of 7 per cent. in speed; this latter method has therefore been adopted.

The difficulties experienced in connection with the problem of synchronism have also been overcome, as well as that of facilitating the regulation of the apparatus.

The latest apparatus represent an improved construction of those described above, and the experiments already carried out have

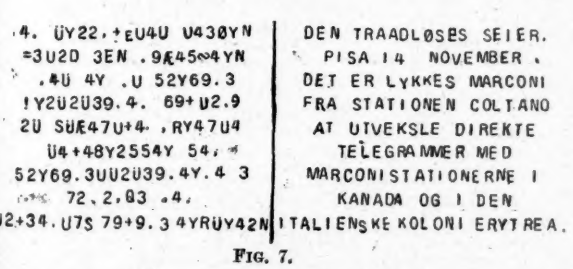


FIG. 7.

ustified all expectations in regard to safe working, as well as the possibility of preserving secrecy in the transmission of wireless messages.

The latter is dependent upon the cryptographic cipher in accordance with which the apparatus in question have been adjusted, and fig. 7 shows a *facsimile* of one and the same message, received by two stations with different cryptographic ciphers, of which the one is correct (in Norwegian) while the other is without any sense at all.

The number of different alphabets which can be used in connection with these apparatus is 720, and this can be increased to 5,040 by adding one impulse to the present number.

The distances at which the experiments with wireless telegraphy have been carried out are only small; but the system has very little to do with the question of distance, because it is applicable to all the existing systems, and may thus be worked in connection with one as well as with another.

Assuming that a system is capable of transmitting messages over a distance of, say, 1,000 miles, the message being received in Morse letters, the present system if used in connection with the former will enable the receiving station to obtain the messages in ordinary type.

The advantage of having a wireless system in the Navy, which is quite reliable in regard to the transmission of secret messages, need not be pointed out; and, as far as mercantile vessels are concerned, the introduction of this system may do away with the necessity of keeping a salaried expert on board for wireless telegraphy only, which means economy, and consequently will facilitate the introduction of wireless on ships in general.

During the experiments it has been proved that quite inexperienced persons have been able to forward perfectly correct messages, which would be impossible with the existing methods.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"A. U. L." writes: "I should esteem it a favour if you could give me your opinion of the following position of affairs that has arisen in this district. The Town Council are part owners in the electricity scheme; the gas undertaking belongs to a company.

"A competitive street lighting scheme has been carried out between the two rival illuminants, and by a small majority the Town Council has decided to adopt gas lighting.

"At least two members of the Town Council who voted are directors of the gas company, and several other members of the Town Council are interested as shareholders. Can they legally vote in favour of gas?"

*** It is not quite clear whether the Council in question is an Urban District Council, and so governed by the Public Health Act, 1875, or a Borough Council subject to the Municipal Corporations Act, 1882. Sec. 46 of the Public Health Act, 1875, provides that: "A person shall be disqualified for being elected or being a member or chairman of a Council of a parish or of a district *other than a borough*, or of a board of guardians if he . . . . (*c*) Is concerned in any bargain or contract entered into with the Council or board, or participates in the profit of any such bargain or contract, or of any work done under the authority of the Council or board. . . . . (2) Provided that a person shall not be disqualified for being elected or being a member or chairman of any such Council or board by reason of being interested. . . . . (*c*) In any contract with the Council or board as a shareholder in any joint stock company; but he shall not vote at any meeting of the Council or board on any question in which such company are interested, except that in the case of a water company or other company established for the carrying on of works of a like public nature, this prohibition may be dispensed with by the County Council." Assuming that the Council referred to by "A. U. L." is an Urban District Council—and assuming, further, that the supply of gas or electricity for street lighting is a public object (which it apparently is)—it appears that the votes in question were illegal unless the prohibition was dispensed with by the County Council. Sub-sec. (8) of the same section provides that if any person acts when disqualified, or votes when prohibited under this section, he shall for each offence be liable on summary conviction to a fine not exceeding £20. As interest in the contract continues so long as the contract itself exists, and as an injunction may be obtained against an offending member, it will be seen that a formidable weapon is in the hands of those interested in electric lighting. The terms of the Municipal Corporations Act, 1882, Sec. 12, are very similar to those above set out. Interest in contracts is a disqualification, save that to hold shares in "any company which contracts with the Council for lighting, or supplying with water or insuring against fire any part of the borough" is no disqualification. Nevertheless, by Sec. 22 (3) of the same Act, a member may not vote or take part in the discussion of any matter before the Council, or a committee, in which he has directly or indirectly, by himself or by his partner, any pecuniary interest. Enough has been said to show that, whatever the view of the Council (*i.e.*, whether "Urban District" or "Town"), there is probably a *prima facie* case against the councillors concerned; but it would be advisable to see a solicitor before taking any serious step.

Imports into Tunis.—The Central Bureau for the Preparation of Commercial Treaties, which is a German private undertaking which has assumed the responsibility for watching over changes in Customs and the effects of commercial treaties in so far as they affect, or may affect, Teutonic foreign trade, has just drawn attention to the question of foreign competition in French colonies, with special reference to the report of the German Consul in Tunis for 1910. It is pointed out that the preference given to French products in Tunis renders it difficult for foreign rivals to succeed, and that the authorities have their requirements of materials met from the same sources as the French authorities do in France, thus closing a large market to other nations. By way of illustration of the Tunisian import trade, it is mentioned that electrical machinery of the value of £7,080 was procured from France in 1910, as against £480 from Germany; French induction apparatus of the value of £6,000, as compared with £240 from Germany, and French machine tools for £4,800, as contrasted with £360 from Germany. Similar differences exist in regard to metal work, tools, railway materials and trucks, machinery, elevators, &c. These cases render it comprehensible, the Central Bureau remarks, that German manufacturers must raise emphatic objections to the "Tunisisation" of other countries—meaning Morocco—which have hitherto stood open to free competition.

A Patents Exhibition.—We are informed that London is to have a permanent Exhibition of Patents, which will be situated in a central position, and will be open to the public all the year round. It will form a centre where inventors can display their patents for the purpose of attracting the attention of possible purchasers. Further particulars are contained in the prospectus, which, we are informed, may be had on application to the Administration Office, 165, Fleet Street, E.C.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

19,194. "Electric lamp." VAN RADEN & Co., LTD., and M. METZ. August 28th.

19,195. "Driving wheels of magneto machines used with internal-combustion engines." ABINGDON ECCO., LTD., and J. GRAY. August 28th.

19,210. "Electrical appliance for transmitting messages, with provision for taking a record of each message and notifying the record to the sender of the message." D. S. DAVIES and C. H. MASON. August 28th.

19,228. "Electrically-operated sewing machine." G. LEVY. August 28th.

19,230. "Circuit arrangements for automatic telephone systems." SIEMENS AND HALSKE AKT.-GES. (Addition to 19,187/11. Convention date, August 27th, 1910, Germany.) August 28th. (Complete.)

19,231. "Circuit arrangement for automatic telephone systems." SIEMENS AND HALSKE AKT.-GES. (Convention date, August 27th, 1910, Germany.) August 28th. (Complete.)

19,233. "Device for short-circuiting the current of magneto-electric ignition apparatus." Firm of ROBERT BOSCH. (Convention date, May 15th, 1911, Germany.) August 28th. (Complete.)

19,242. "Anti-vibrators for electric light pendants." H. W. HANWELL. August 28th.

19,252. "Telephone station." C. G. REDFERN. (Telephon-Automaten Ges. m.b.H., Austria.) August 28th. (Complete.)

19,260. "Systems of electrical distribution." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) August 28th.

19,266. "Electrical couplings." C. R. BELLING. August 29th.

19,268. "Electric motors suitable for display advertising devices and the like." A. C. HARRIS. August 29th.

19,297. "Ignition apparatus." V. DANICEK, K. CERNOVSKY and A. HOFFMANN. August 29th.

19,305. "Electric furnaces." A. L. J. QUENEAU. August 29th. (Complete.)

19,312. "Arc lamps." G. E. TATE and F. O. MONKHOUSE. August 29th.

19,344. "Magnetic hairpin." F. DE LATOUR. August 30th.

19,347. "Electric safety hand-lamps." SIMPLEX CONDUITS, LTD., and C. G. M. BANNETT. August 30th. (Complete.)

19,359. "Making steam by electricity for all marine steam boilers and other boilers and the like." G. S. HOLME. August 30th.

19,360. "Electrolytic coating of iron, steel, or other metals with zinc or zinc alloys." Q. MARINO. August 30th.

19,362. "Speed regulation of electric motors." J. WAGNER. August 30th.

19,363. "Electric measuring instruments." J. L. ORCHARD. August 30th.

19,365. "Electric controllers." BRAY, MARKHAM & REISS, LTD., E. N. BRAY, F. R. MARKHAM and F. E. REISS. August 30th.

19,392. "Excess-current switches." FELTEN & GUILLEAUME CARLSWERKE AKT.-GES. (Convention date, August 30th, 1910, Germany.) August 30th. (Complete.)

19,435. "Electric arc lamps." GES. FUR MASCHINEN-U. METALL-INDUSTRIE m.b.H. (Convention date, September 1st, 1910, Germany.) August 31st. (Complete.)

19,444. "Apparatus for perforating the signal-controlling tape to be used with automatic telegraph transmitters." W. JUDD, A. FRASER and EASTERN TELEGRAPH Co., LTD. August 31st.

19,456. "Circuit arrangement for automatic or semi-automatic telephone exchanges." SIEMENS & HALSKE AKT.-GES. (Convention date, November 8th, 1910, Germany.) August 31st. (Complete.)

19,518. "Electrolytic treatment of nitric acid." FARBWERKE VORM. MEISTER, LUCIUS & BRUNING. (Convention date, December 24th, 1910, Germany.) September 1st. (Complete.)

19,525. "Electric arc lamps." SOC. ANON. FRANCAISE DITE BANQUE DU RADIUM. (Addition to 28,888/10. Convention date, May 26th, 1911, France.) September 1st. (Complete.)

19,526. "Arc lamps." SOC. ANON. FRANCAISE DITE BANQUE DU RADIUM. (Addition to 28,888/10. (Convention date, January 2nd, 1911, France.) September 1st. (Complete.)

19,553. "Electrical connecting apparatus operated from a distance." G. A. BETULANDER. (Convention date, September 3rd, 1910, France.) September 2nd. (Complete.)

19,573. "Arrangements for automatic telephone systems." SIEMENS AND HALSKE AKT.-GES. (Convention date, October 12th, 1910, Germany.) September 2nd. (Complete.)

19,583. "Protective devices for electrical apparatus." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States). September 2nd.

19,684. "Electrical fuse devices." J. E. SPAGNOLETTI and V. E. JOYCE. September 2nd.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

WIRELESS SIGNALLING. R. H. Fessenden. 11,154. May 5th. (January 29th, 1910.)

MAGNETO-ELECTRIC IGNITION APPARATUS FOR INTERNAL-EXPLOSION ENGINES. R. F. Hall. 16,093. July 6th.

ELECTRICAL APPARATUS. H. E. Reeve. 16,172. July 6th.

ELECTRICITY METERS. W. H. Johnson and A. M. Billington. 18,470. August 4th.

APPARATUS FOR TREATING LIQUIDS BY MEANS OF ULTRA-VIOLET RAYS. V. Henri, A. Helbronner and M. von Recklinghausen. 18,762. August 9th.

SOCKET FOR FIXING ELECTRIC LAMPS. Etablissements Pax & Silva. 20,040. August 26th. (June 28th, 1910.)

ELECTRICALLY OPERATED PLAYING APPARATUS FOR MUSICAL INSTRUMENTS. C. M. Clark. (Telelectric Co.) 20,095. August 29th.

APPARATUS FOR VARYING THE MEAN POTENTIAL OF STARTING MACHINES (DISTRIBUTING DYNAMO MACHINES). Allgemeine Elektricitäts Ges. 20,759. September 6th. (September 6th, 1909.)

DETECTORS FOR USE IN CONNECTION WITH ELECTROMAGNETIC WAVES. J. C. Smith and T. H. Lyon. 22,164. September 24th.

METHOD OF SUPPORTING AND INSULATING THE OVERHEAD WIRES IN ELECTRIC TRAMWAYS AND RAILWAYS. C. Mittelhausen and A. R. Williams. 22,735. October 1st.

MEANS FOR SUPPORTING ELECTRIC LAMPS. H. T. Harrison. 22,775. October 1st.

ELECTRODES FOR ARC LAMPS. F. M. Lewis. 22,803. October 1st.

PROCESS FOR THE MANUFACTURE OF METALLIC FILAMENTS FOR ELECTRIC LAMPS. J. Schilling. 23,689. October 19th. (December 29th, 1909.)

TERMINAL FOR HIGH AND LOW-TENSION ELECTRIC CONDUCTORS. C. Meigh. 23,891. October 15th.

MEANS FOR DRIVING MAGNETO-ELECTRIC MACHINES FOR INTERNAL-COMBUSTION ENGINES. J. C. Merryweather. 26,409. November 14th.

CONVERSATIONS COUNTER FOR TELEPHONES WITHOUT CRANK-HANDLES. K. Born. 27,857. November 30th.

ELECTRODES FOR ELECTRIC FURNACES. M. Ruthenburg. 28,536. December 8th.

COMMUTATORS FOR ELECTRICAL MACHINES. Vickers, Ltd., A. D. Williamson and H. F. Brown. 29,161. December 15th.

MAGNETO GENERATOR. F. W. Golby. (Draper-Latham Magneto Co.) 30,166 and 30,167. December 29th.

1911.

APPARATUS FOR THE ELECTROLYSIS OF FUSED ALKALI CHLORIDES. Ges. Fur Chemische Industrie in Basel. 17,047. July 25th. (December 22nd, 1909. Divided application on No. 18,300 of 1910, August 2nd.)

CONTROLLING APPARATUS FOR ELECTRIC MOTORS. Otis Elevator Co. (Otis Elevator Co.) 498. January 7th.

DYNAMO-ELECTRIC MACHINES. O. F. Sire. 2,903. February 4th. (February 14th, 1910.)

ELECTRIC CONTACT KEYS OR THE LIKE. W. M. Crowe and British L. M. Ericsson Mfg. Co. 5,564. March 6th.

METHOD OF ELECTRICALLY BRAKING POLYPHASE SERIES MOTORS. Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke Ges.) 7,631. March 27th.

INCANDESCING BODIES FOR ELECTRIC LAMPS AND METHODS OF MANUFACTURING THE SAME. K. Schwab. 8,004. March 20th. (April 9th, 1910.)

TRANSMITTERS AND RECEIVERS FOR WIRELESS TELEGRAPHIC AND TELEPHONIC APPARATUS. E. Bellini. 11,339. May 10th.

ELECTRIC ARC LAMPS. Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke.) 12,735. May 26th.

THERMO-ELECTRIC BATTERIES. Dr. P. H. Süchting and F. Oloff. 13,715. June 8th.

ELECTRO-DEPOSITION OF METALS. A. Rodeck. 13,808. June 9th. (June 10th, 1910.)

Electrical Progress in Sweden.—The Committee of Electrical Inspectors has during the year 1910 expressed its views with regard to 137 questions dealing with electrical matters which have come before the Government for approval. Among other matters the inspectors point out the desirability of adopting more practical and simple methods for dealing with applications for concessions for carrying out electrical works, recommending that such matters should be subjected to the decision of local authorities instead of having to pass the Government as at present.

Up to the end of 1910 the Government had granted a total of 910 applications for electrical concessions, of which 127 were granted during 1910. The long-distance transmission concessions represented a total of 253,300 H.P., the distance aggregating 2,400 miles; the corresponding figures for 1910 were 50,260 H.P. and 285 miles. Nearly all these concessions relate to the transmission of energy from waterfalls. There is only one railway line which is electrically operated, namely, the line from the iron ore deposits at Kuruna to the Norwegian frontier. There are 16 tramway lines, almost all of which are municipal undertakings; the total length of single track amounts to 180 miles, and the total number of passengers carried by these lines up to the end of 1910 amounted to 964 millions, and the receipts to about £500,000, more than half of which falls to the tramways of Stockholm, N.

It is of interest to note that an aluminium cable of 160 mm². has been employed between Bullarforsen and Domnarfvet, the span occasionally running up to as much as 425 metres.

Electrical Labour in Australia.—The annual report of the Australian Electrical Trades Union contained the following remarks:—"The continued activity of the building industry, the extension of the tramway system, and the increasing demand for electric light and power—largely due to the enterprise of the Sydney Municipal Council, as well as a number of private supply companies in the various parts of the State, has been responsible for the prosperous condition of the electrical industry during 1910-11, which gratifying state of affairs is likely to continue for some time. It must, however, be remembered that, although occasionally there has been a shortage of labour, much of the work is of a casual nature, and during the period under review, many excellent mechanics have experienced a lot of broken time. Generally speaking, supply and demand are fairly evenly balanced at the present moment. The union employment bureau has been of service to both employers and employés; over 200 jobs in city and country, covering all branches of the trade (some of them permanent) have been found for our members."

Picnic.—Last Saturday the staff of the Carnarvon and Bangor branches of the National Electric Construction Co. held their first picnic, which took the form of a drive through the Vale of Bettws Garmon to Beddgelert, where lunch was partaken of at the Saracen's Head Hotel. A football match—Carnarvon *v.* Bangor—was then played, resulting, after a strenuous game, full of exciting moments, in a victory for Bangor. The party then proceeded to the power station of the North Wales Power Co., in Cwm Dyli, which, through the good offices of Mr. D. O. Evans, they were allowed to inspect. Afterwards followed a stiff climb up to Penypass, and a continuance of the drive to the Dolbadarn Hotel, Llanberis, where a sumptuous tea was provided, Mr. Evans playing the *rôle* of host. After tea, Mr. Evans conveyed the good wishes of everyone to Mr. D. Tullis, who is leaving the company to take up a better appointment in one of the South African mines. Mr. R. Lloyd Roberts, on behalf of the Carnarvon staff, and Mr. R. Gordon Roberts, for the Bangor branch, thanked Mr. Evans for his company and for the generous manner in which he had treated the staff on this their first outing. After further speeches the party then drove back to Carnarvon.